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Analytical Hierarchy Process for Optimizing Shorebase Cost: A Case Study in East Java Offshore National Oil & Gas Company

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ABSTRACT

This research addresses the need to optimize shorebase logistics costs for the East Java Offshore National Oil & Gas Company amid declining production and rising operational expenses. The study aims to determine the most efficient shorebase operation method by evaluating three alternatives: maintaining the current rental warehouse in Lamongan, relocating to a company-owned warehouse in Cepu, or moving to another rental warehouse in Gresik. Using a Multi-Criteria Decision-Making (MCDM) approach with the Analytical Hierarchy Process (AHP), data were collected through Focus Group Discussions with supply chain experts and surveys from competent respondents. Key criteria included operation cost, mobilization cost, and handling efficiency. Results indicate that maintaining the existing Lamongan shorebase is the optimal choice, followed by relocating to the owned warehouse. The study demonstrates the applicability of AHP in integrating quantitative and qualitative factors for strategic logistics decision-making, with implications for cost efficiency and operational stability in upstream oil and gas operations.

KEYWORDS *Shore Base; Analytical Hierarchy Process, Shore Base Operation*

INTRODUCTION

For energy consumption in Indonesia until today still depends on fossil fuel (Cuevas et al., 2020; Fairuz et al., 2023; Liu et al., 2025; Yang et al., 2018). Coal and petroleum are the major energy source for day to day living according to Indonesia Energy Outlook in 2023, with portion of 45% from oil and gas contribution (IEA, 2023; ERIA, 2023). With the potential natural source in Indonesia and concerning of energy transition in Indonesia undergoing, so the exploiting oil & gas natural resources in Indonesia is major concerning which is stated in ASTA CITA of Indonesian Government (PwC, 2025; IESR, 2024). The country remains heavily dependent on fossil fuels—coal, oil and natural gas continue to dominate the energy mix (Chester & Overland, 2022; IRENA, 2022; "Addressing Indonesia's Fossil Fuel Dependence", 2023). This reliance presents both a challenge and opportunity as the transition to renewables is still in its early phases and policy-inconsistencies persist (East Asia Forum, 2025).

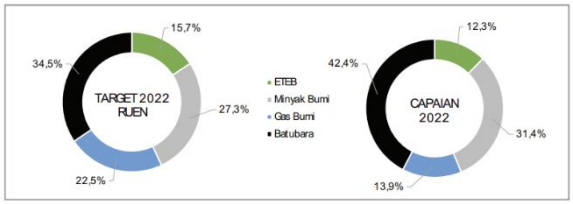

Figure 1. Indonesia energy consumption
source "Indonesia Energy Outlook 2023, Secretary General of the National Energy Council"

Exploiting oil & gas in Indonesia can be divided into two main divisions: the onshore and offshore exploitation. Onshore exploitation is mainly based on mining and producing oil & gas inland, such as in plain areas, farm fields, forests, steppes, or even deserts. Offshore-based exploitation operates in water-based areas such as swamps, rivers, or oceans, usually using water-floating platforms (Iswara, 2022; Chandra, 2025). Onshore and offshore-based operations impact the fulfillment of operational needs, one of which is logistics. Logistics for onshore-based operations are directly located inland, with considerations such as distances between warehouses and field operations, manpower, and regulations in some areas, especially in Indonesia (Fairuz et al., 2023; Resnamurti & Anwar, 2025). Offshore-based exploitation concerns warehouses, which are typically onshore—commonly near coasts, ports, or other shore locations that connect warehouses to water-floating platforms (Fairuz et al., 2023; Resnamurti & Anwar, 2025).

East Java Offshore National Oil & Gas Company is one of the Indonesian National Oil & Gas Companies located in East Java Province with operations in North Madura Offshore. With oil and gas production, the company dominates gas production for supplying energy needs for electricity and manufacturers in Surabaya, Gresik, and Sidoarjo. The business process in this company can be shortly described as exploration and exploitation of oil & gas. Oil & gas are extracted from the subsurface and purified at the surface in production facilities before being monetized or traded to customers. The phase of transferring oil & gas from wells to facilities and customers is called transportation.

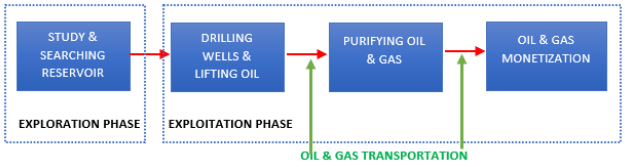

Figure 2. Business Process in East Java Offshore National Oil & Gas Company

With the need of Logistics support for its operation, this company now using the shore base warehouse located in Lamongan, often called Lamongan Shore Based (LSB) since 2015. East Java Offshore National Oil & Gas Company using LSB, with rental based contract by paying of square meters area that is used by company. So the more area used by East Java Offshore National Oil & Gas Company, more cost will be paid to Lamongan Shore Based owner. And with the concern of efficiency in East Java Offshore National Oil & Gas Company which had gained decreasing oil & gas production, which also contributing decreasing in revenue and profit. Now East Java Offshore National Oil & Gas Company wants to evaluate of optimalization in Logistic cost in rental Lamongan Shore Based or moving to other place which may offer best option for logistic cost optimalization.

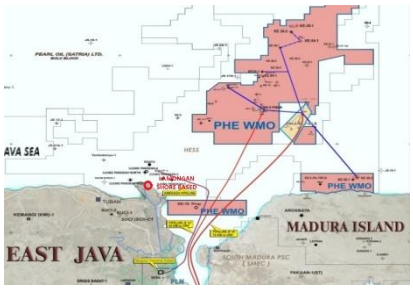

Figure 3. Operation Map East Java Offshore National Oil & Gas Company

One of the methods in Decision Making is by Multi Criterion Decision Making by Analytic Hierarchy Process or so called AHP. The Analytical Hierarchy Process had been commonly used for decision making because of the simple method by comparing all factors / criterion and also alternatives / scenarios for grading the alternatives. By comparing and later on grading the alternatives, AHP can give better quantitative typed method for decision that data collected for this method almost in qualitative type.

According from "(Saaty and Vargas, 2012, 3 – 9), at least AHP has 3 (three) level hierarchy of Goal, Criterion, Alternatives. Because of AHP is one of MCDM tools, so the phase of AHP will be the same of MCDM. The most challenging phase of AHP will be "Create all criterion related to upcoming goal". The criterion formed have to measuring the internal and external factor leading to the goal. More criterion can be interpreted of more aspect and exposure explored thoroughly for making better goal or decision.

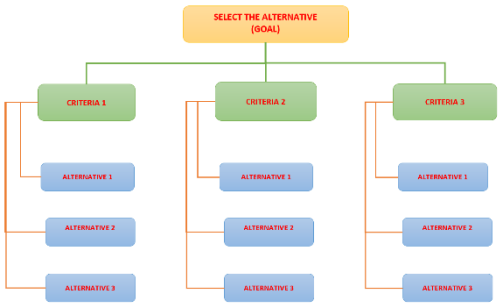

Figure 4. AHP with three level hierarchy

Intensity of importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
2	Weak	
3	Moderate importance	Experience and judgment slightly favor one activity over another
4	Moderate plus	
5	Strong importance	Experience and judgment strongly favor one activity over another
6	Strong plus	
7	Very strong or demonstrated importance	An activity is favored very strongly over another; its dominance demonstrated in practice
8	Very, very strong	
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation
Reciprocals of above	If activity i has one of the above nonzero numbers assigned to it when compared with activity j, then j has the reciprocal value when compared with i	A reasonable assumption
Rationals	Ratios arising from the scale	If consistency were to be forced by obtaining n numerical values to span the matrix

Figure 5. Fundamental Scales of AHP based on Saaty and Vargas

Cited from "(Saaty and Vargas, 2012, 24 – 25), there are seven pillars of AHP:

a. Ratio scales, proportionality and normalised ratio scales.
b. Reciprocal paired comparisons.
c. The sensitivity of the principal right eigen vector
d. Clustering and using pivots to extend the scale.
e. Synthesis to create a one-dimensional ratio scale for representing the overall outcome.
f. Rank preservation and reversal.
g. Integrating group judgements

For shore-based warehouse cased in this research, there are criterions for a shore-based warehouse according to Subject Matter Expert with the mediation of East Java Province regulation. Selecting shore-based for supporting operation in Offshore in East Java Offshore National Oil & Gas Company will be concerning:

a. Operation Cost: Lower of the price or cost of the warehouse will be more efficient
b. Mobilization Cost: Lower of the price or cost of the warehouse will be more efficient. But not the same direction form Operation Cost, while lower or no cost in mobilization then higher the operation cost in inbounding logistic operation
c. Handling Operation: Subjectivity of warehouse crews while performing logistic operation in warehouse
d. Distance of warehouse to the ports: Longer the distance will be longer the time and higher the cost in mobilization or even in operation cost
e. Other factors such as manpower, tools readiness and also weather for easiness in ship operation during loading / unloading materials.

Based on findings from multiple scholarly sources, the application of the Analytical Hierarchy Process (AHP) in logistics and supply chain optimization is well-documented. For instance, Sahroodi et al. (2012) and Rouyendegh & Erkan (2011) successfully demonstrated the efficacy of AHP in supplier selection, highlighting its strength in handling both tangible and intangible criteria. Similarly, research by Burganova et al. (2021) and Czerniachowska & Lutosławski (2023) applied decision-making models to optimize internal logistics and warehouse management processes, focusing on efficiency and time reduction. These studies collectively affirm the robustness of Multi-Criteria Decision-Making (MCDM) methods in solving complex operational problems within various industrial contexts.

Despite the proven utility of AHP in general logistics, a discernible research gap exists in its specific application to shorebase operations within the upstream oil and gas sector. The existing literature, such as the work by Saleh et al. (2020) which applied AHP to procurement in a gold mining project, often focuses on procurement or supplier selection rather than the holistic optimization of a shorebase—a critical logistics node connecting onshore support and offshore platforms. The unique cost structure, involving a direct trade-off between operational, mobilization, and handling costs under stringent government regulations (PTK 007), presents a problem domain that has not been sufficiently explored using structured decision-making frameworks.

The urgency of this research is propelled by the pressing economic challenges faced by the East Java Offshore National Oil & Gas Company. With declining hydrocarbon production and subsequent reductions in revenue, there is an immediate operational and financial imperative to identify and implement cost-optimization strategies across all business units. The shorebase, as a significant center of logistics expenditure, represents a substantial opportunity

for cost savings. Improving its efficiency is not merely a matter of corporate profitability but is also crucial for ensuring the economic sustainability of energy operations that supply electricity and manufacturing sectors in the East Java region.

The novelty of this study lies in the tailored integration of AHP to address the specific tri-lemma of shorebase costs—operation, mobilization, and handling ease—within the unique regulatory framework of Indonesia's upstream oil and gas industry. By deriving its criteria directly from Subject Matter Experts (SMEs) via Focus Group Discussions, this research grounds its analytical model in real-world operational expertise, a approach not commonly detailed in previous studies. This context-specific application provides a novel decision-support tool for logistics managers in similar offshore environments.

Therefore, the primary purpose of this research is to determine the most efficient shorebase operation method for the case study company by systematically evaluating three alternatives. The intended benefits are twofold: firstly, to provide management with a scientifically-grounded and transparent rationale for strategic decision-making, enhancing the objectivity of the logistics planning process. Secondly, the successful implementation of the chosen alternative is expected to yield significant cost reductions, thereby contributing directly to the company's financial resilience and the continued reliability of its energy supply operations.

METHOD

This research employs a mixed-methods approach, combining qualitative and quantitative techniques to address its objectives. The qualitative aspect was operationalized through a Focus Group Discussion (FGD) involving five Subject Matter Experts (SMEs) from the company's Supply Chain Management division, selected via a purposive sampling technique based on their extensive experience and professional certifications. The FGD utilized a guided discussion protocol as its primary instrument to identify and define the critical criteria (Operation Cost, Mobilization Cost, and Handling Operation) and the decision alternatives for the AHP model. This qualitative foundation was essential for structuring the quantitative phase, ensuring the model's relevance to the specific operational context.

For the quantitative data collection, the population comprised professionals and operators within the company's logistics and supply chain network. A purposive sampling technique was again employed to select eleven competent respondents who possess direct operational knowledge relevant to the shorebase activities. The research instrument was a structured survey questionnaire based on the Saaty's pairwise comparison scale (1-9), designed to capture respondents' judgments on the relative importance of the criteria and alternatives. The data analysis technique was the Analytical Hierarchy Process (AHP), which involved constructing pairwise comparison matrices, calculating priority weights, and performing consistency checks (Consistency Index and Consistency Ratio) to validate the respondents' judgments and synthesize the results to determine the optimal shorebase alternative.

Logistic Operation in Upstream Oil & Gas Industry

Managing logistic operation in Indonesia Upstream Oil & Gas in under regulation of Indonesian Government (represented by SKK Migas) with 1 standard operating procedure thru “PTK 007 Buku Ketiga” with second amandment in 2022.

Figure 6. Asset Regulation in Indonesian Upstream Oil & Gas

For upstream Oil & Gas Companies which operates under SKK Migas, Logistic materials will called "Assets" is under management of Indonesia Government (represented of Energy & Mineral Natural Resources Ministry – ESDM), while those assets in Indonesian area regardless under purchasing of a upstream oil & gas company. By end to end, assets management in upstream oil & gas company will be shown in :

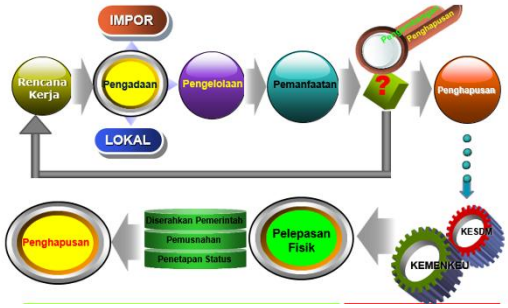

Figure 7. Asset Management on Indonesia Upstream Oil & Gas

Based on Figure 7 managing asset from purchasing and "releasing" will be take time because in need of approval from Indonesia government. So the need of warehouse in Upstream Oil & Gas business will be a primary needs for keeping materials and also in need of supporting continuity operation in offshore oil & gas exploitation.

Forum Group Discussion and Survey

For data collection, author using 2 (two) approaches of data collection, by using Forum Group Discussion to Subject Matter Experts (SME) and Survey to Competent respondents. Forum Group Discussion performed by author by inviting expertise in SCM Division who has experiences and competencies in Supply Chain especially in Procurement and Contracting. FGD attendants:

a. SCM Logistic Manager, 25 years experienced, Logistic certified
b. SCM Zone Manager, 17 years experienced, Procurement, Logistic & Warehouse management certified. Including the author of the research.
c. Assistant Manager, 17 years experienced, Logistic Certified.

d. Internal Support, 15 years experienced, CSCA (Certified Supply Chain Analysist)
e. Warehouse Analyst, 10 years experienced, CSCA (Certified Supply Chain Analysist)

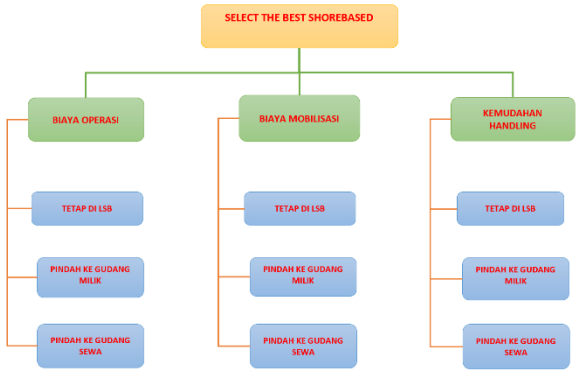

Figure 8. AHP Hierarchy – Decision Structure Based on FGD

FGD itself is discussing of the criterion and also alternatives for improving contract type suitable for optimizing engine (compressors and pumps) performances,. Based on those FGD and plotting in figure 8.

After criterion and alternatives based on previous FGD, for next data collection by surveys to competent respondents. Respondents given by some question regarding of criterion and alternatives and they will give number based on table:

Table 1. Table Parameter of survey

Value	Verbal Description	Explanation
1	Equal importance	Two activities contribute equally to the objective
3	Moderate importance of one over another	Experience and judgement slightly favor one over another
5	Strong importance of one over another	Experience and judgment strongly favor one over another
7	Very strong importance of one over another	Activity is strongly favored and its dominance is demonstrated in practice
9	Extreme importance of one over another	Importance of one over another affirmed on the highest possible order

And the survey matrix based on this research will be:

Table 2. Table Rating of surveys

Pairwise Comparison	Resp 1	Resp 2	Resp 3	Resp 4	Mean
Operating Costs					
Stay Op Lsb					Moving to a Warehouse
Stay Op Lsb					Moving to another rental warehouse
Moving to a Warehouse					Moving to another rental warehouse
Mobilization Costs					
Stay Op Lsb					Moving to a Warehouse
Stay Op Lsb					Moving to another rental warehouse
Moving to a Warehouse					Moving to another rental warehouse
Ease of Handling					
Stay Op Lsb					Moving to a Warehouse
Stay Op Lsb					Moving to another rental warehouse
Moving to a Warehouse					Moving to another rental warehouse
Operating Costs					Mobilization Costs
Operating Costs					Ease of Handling

Mobilization Costs	Ease of Handling

After survey results, the next step will be making pairwise comparisons as table 2. Then author will rate the relative importance between each pair of decision alternatives and criterion. Consistency Check will be simulated before doing synthesize the results to determine the best alternative.

RESULT AND DISCUSSION

Criterion and Alternatives

From FGD earlier then can be obtainer 3 (three) criterion and 3 (three) alternatives.
Criterion:

a. Operation Cost: Cost for daily operation in warehouse such as man power, tools, utility and other costs in warehouse until loading to the ships. The cheaper, the more efficient.
b. Mobilization Cost: Cost that occurs when moving or mobilizing materials between other places or other warehouse before loading to the ship in ports to offshore platforms. Mobilization Cost often in opposite relationship to Operation Cost, and combination of them will be called Total Logistic Cost or Total Handling Cost.
c. Handling Operation: Term of quality for conducting operation from warehouse to ship such as activity of handling between other tools, using forklifts or cranes, and other clearance before – after loading materials into ships. Handling operation will have directional relationship with Operation Cost and opposite relationship in Mobilization Cost.

Alternatives based on discussion:

a. Stay on Existing Shorebase: Extending the contract rental warehouse in Lamongan Shore Based for Logistic operation of East Java Offshore National Oil & Gas Company. Because in term of more secure in handling operation and minimum of Mobilization Cost for warehouse operation especially in daily operation
b. Moving to Own Warehouse: Mobilizing all materials from Lamongan Shore Based to Own Warehouse of sister company of East Java Offshore National Oil & Gas Company located in Cepu (Middle Java Province). Can gain minimum Operating Cost but will be higher in Mobilization Cost to the ship port.

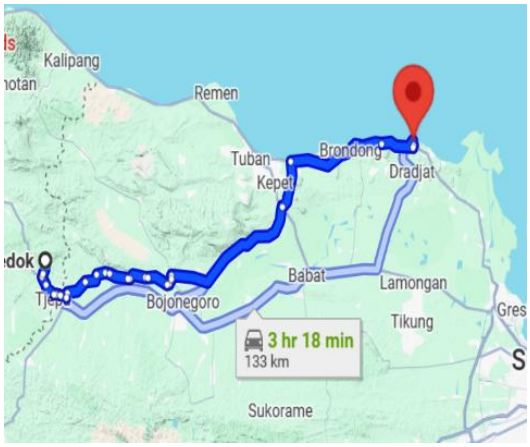

Figure 9. Cepu Warehouse to the Port

c. Moving to another Rental Warehouse

Mobilizing all materials from Lamongan Shore Based to other Rental Shore Based Warehouse of sister company of East Java Offshore National Oil & Gas Company located in Gresik near the market of gas product. Can gain minimum Operating Cost but will be higher in Mobilization Cost to the ship port but easiness in handling.

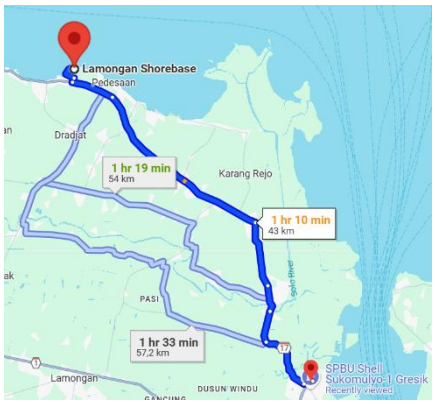

Figure 10. Other Warehouse to the Port

Selection of Contract Type by AHP

This AHP begins with pairwise comparison conducted by result of weighted average from survey result of criterion and alternatives as shown in table 3. From that result, can be formed the first level of pairwise comparison of the criterion as shown in table 4.

The next step will be calculating for the priority of the alternatives from each criterion as shown in table 5. Also, in this step we will calculate consistency check by finding consistency index (CI) and consistency ratio (CR).

Table 3. Weighted average calculation based on survey result on respondents

Pairwise Comparison	Resp 1	Resp 2	Resp 3	Resp 4	Resp 5	Resp 6	Resp 7	Resp 8	Resp 9	Resp 10	Resp 11	Mean	
Operating Costs													
Stay Op Lsb	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	Moving to a Warehouse
Stay Op Lsb	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	Moving to another rental warehouse
Moving to a Warehouse	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	Moving to another rental warehouse
Mobilization Costs													
Stay Op Lsb	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	Moving to a Warehouse
Stay Op Lsb	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	Moving to another rental warehouse
Moving to a Warehouse	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	Moving to another rental warehouse
Ease of Handling													
Stay Op Lsb	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	Moving to a Warehouse
Stay Op Lsb	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	Moving to another rental warehouse

Pairwise Comparison	Resp 1	Resp 2	Resp 3	Resp 4	Resp 5	Resp 6	Resp 7	Resp 8	Resp 9	Resp 10	Resp 11	Mean	
Moving to a Warehouse	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	Moving to another rental warehouse
Operating Costs	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	Mobilization Costs
Operating Costs	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	Ease of Handling
Mobilization Costs	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	Ease of Handling

Table 4. First Level Pairwise Comparison on criterion

CRITERION	OPS FEES	MOB FEES	HANDLING
OPS FEES	1.000	3.000	1.000
MOB FEES	0.333	1.000	0.200
HANDLING	1.000	5.000	1.000

Table 5. Pairwise Comparison Alternatives to all criteria

OPS FEES	STAY AT LSB	MOVING G. MILIK	MOVING G. RENT
STAY AT LSB	1.000	1.000	5.000
MOVING WAREHOUSE	1.000	1.000	3.000
MOVING RENTHOUSE	0.200	0.333	1.000

MOB FEES	STAY AT LSB	MOVING G. MILIK	MOVING G. RENT
STAY AT LSB	1.000	5.000	5.000
MOVING WAREHOUSE	0.200	1.000	1.000
MOVING RENTHOUSE	0.200	1.000	1.000

HANDLING	STAY AT LSB	MOVING G. MILIK	MOVING G. RENT
STAY AT LSB	1.000	1.000	5.000
MOVING WAREHOUSE	1.000	1.000	3.000
MOVING RENTHOUSE	0.200	0.333	1.000

For consistency check is by applying formulas of :

$$CI = \frac{\lambda_{max} - n}{n-1} \text{ and } CR = \frac{CI}{RI}$$, where RI :

Table 6. Random Index (RI) table based on N Alternative

N	RI
1	0.00
2	0.00
3	0.58
4	0.90
5	1.12
6	1.24
7	1.32
8	1.41
9	1.45
10	1.49

Table 7. Development Priority and consistency check to all criterion

Development Of Priority Ranking

Criterion	Ops Fees	Mob Fees	Handling
Ops Fees	1.000	3.000	1.000
Mob Fees	0.333	1.000	0.200
Handling	1.000	5.000	1.000
Column Total	**2.333**	**9.000**	**2.200**

Criterion	**Ops Fees**	**Mob Fees**	**Handling**	
Ops Fees	0.429	0.333	0.455	
Mob Fees	0.143	0.111	0.091	
Handling	0.429	0.556	0.455	
				Row Average
				0.405
				0.115
				0.480
Ops Fees	0.405	0.345	0.480	**1.000**
Mob Fees	0.135	0.115	0.096	
Handling	0.405	0.575	0.480	
				Weighted Sum
				1.230
				0.346
				1.460

STEP-2

DIVIDE THE ELEMENTS OF THE VECTOR OF WEIGHTED SUMS BY THE CORRESPONDING PRIORITY VALUE

OPS FEES	**3.033**
MOB FEES	3.010
HANDLING	3.044

STEP-3

COMPUTE THE AVERAGE OF THE VALUES COMPUTED IN STEP 2 (λ MAX)

0	
l MAX	3.029

STEP-4

COMPUTE THE CONSISTENCY INDEX (CI)

0	
CI	-0.334

STEP-5

COMPUTE THE CONSISTENCY RATIO (CR)

0	
CR	-0.360
CONCLUSION	**ACCEPTABLE**

Based on the calculation of the consistency check of all criteria and its elements are ACCEPTABLE or CONSISTENT. Because Consistency Ratio (CR) value of all criteria less than 10% (Saaty 1977). Hence, the criteria (and elements or variables) can be calculated into performing next step of AHP process: Synthesize the results to determine the best alternative. The result as shown in table:

Table 8. Priority Ranking Calculation

		OPS FEES	MOB FEES	HANDLING	
		0.405	0.115	0.480	
FROM CONSISTENCY CHECK		ACCEPTABLE	ACCEPTABLE	ACCEPTABLE	
STAY AT LSB	**0.4796**	**0.7143**	**0.4796**	**0.5065**	**BEST ALTERNATIVES**
MOVING WAREHOUSE	0.4055	0.1429	0.4055	**0.3753**	**2ND ALTERNATIVES**
MOVING RENTHOUSE	0.1150	0.1429	0.1150	**0.1182**	**3RD ALTERNATIVES**

Implementation Plan

Decision Making of the Best Option for Shore Based Warehouse to East Java Offshore National Oil & Gas Company according to the AHP simulation before will be presented and reported to the CEO and related Divisions of Operation and also Finance Division. The proposal will be likely:

a. Priority 01 : Stay on LSB (Stay on Existing Shorebase)
b. Priority 02 : Moving to Own Warehouse
c. Priority 03 : Moving to another Rental Warehouse

The Plan of implementation will be:

a. Communication to Finance Division for the proposed expenditure of Logistic Cost.
b. Coordination with Warehouse Crew for more effective operation for ensuring no higher in Operation Cost
c. Placing or Storing material based on First In First Out for ensuring effectiveness on material movement
d. Safety Inspection for tools and other for evading of any unnecessary incident cost
e. Confirming the success rate of project implementation from financial aspect.
f. Keeping monitoring & evaluating

CONCLUSION

This research combines qualitative and quantitative approaches by using Focus Group Discussions with Subject Matter Experts (SMEs) and surveys of competent respondents to identify variables and criteria. The Analytical Hierarchy Process (AHP) supports decision-making by integrating quantitative factors like cost with qualitative operational perspectives, emphasizing the value of expert input. Findings highlight that operation cost and handling ease are key concerns in managing Shore-Based Warehouses for East Java Offshore National Oil & Gas Company. Future research could explore the integration of real-time data analytics and dynamic modeling to enhance decision accuracy and operational efficiency in similar offshore logistics settings.

REFERENCES

Burganova, N., Grznar, P., Gregor, M., & Mozol, S. (2021). *Optimalisation of internal logistics transport time through warehouse management: Case study.* In *14th International*

Scientific Conference on Sustainable, Modern and Safe Transport.

Bushan, N., & Rai, K. (2004). *Strategic decision making: Applying the analytic hierarchy process.* Springer.

Chandra, S. (2025). *A case study of upstream oil & gas logistics in Indonesia: Onshore versus offshore operations. European Journal of Business and Management Research, 10*(1), 12–30.

Chester, L., & Overland, I. (2022). *Untangling the socio-political knots: A systems view on Indonesia's fossil fuel dependency. Energy Research & Social Science, 87,* 102456. https://doi.org/10.1016/j.erss.2022.102456

Cuevas, M. del P. D., Campos, A. P., & Zújar, J. O. (2020). Developing a beach erosion sensitivity indicator using relational spatial databases and Analytic Hierarchy Process. *Ocean & Coastal Management*. https://doi.org/10.1016/J.OCECOAMAN.2020.105146

Czerniachowska, K., & Lutosławski, K. (2023). *Optimising order picking efficiency in a warehouse and distribution center: A flexible flow shop scheduling approach.* In *27th International Conference on Knowledge-Based and Intelligent Information & Engineering.*

East Asia Forum. (2025, February 5). *Indonesia's energy transition needs a decentralised approach. East Asia Forum.*

ERIA. (2023). *Chapter 7: Indonesia country report.* In *2023 Energy Outlook* (pp. …). Economic Research Institute for ASEAN and East Asia.

Fairuz, A., Okdinawati, L., & Nizar, A. (2023). AHP Application to Select Logistical Location in Upstream Oil and Gas Operation: A Case Study. *European Journal of Business and Management Research*. https://doi.org/10.24018/EJBMR.2023.8.5.2073

IEA. (2023). *Indonesia – Energy mix.* International Energy Agency. https://www.iea.org/countries/indonesia/energy-mix

IESR. (2024). *Indonesia energy transition outlook 2023.* Institute for Essential Services Reform.

IRENA. (2022). *Indonesia energy transition outlook.* International Renewable Energy Agency.

Iswara, A. P. (2022). *More is more? The inquiry of reducing greenhouse gas emissions in onshore and offshore petroleum fields in Indonesia. Sustainability, 14*(11), 6865.

Liu, J., Liu, X., Zhu, A., Wang, X., Yu, Q., Chen, L., Al-Musawi, T. J., & Aasal, M. (2025). Prioritization of climate change mitigation strategies for coastal regions using the Analytic Hierarchy Process. *Marine Pollution Bulletin*. https://doi.org/10.1016/J.MARPOLBUL.2024.117516

PWC. (2025). *Oil and gas in Indonesia: Investment, taxation and regulatory guide.* PwC Indonesia.

Resnamurti, D., & Anwar, M. (2025). *Cost reduction by borderless warehouse operation: A case study in National Upstream Oil & Gas Company Zona 11.* In *Proceedings of the 7th International Conference on Management in Emerging Markets (ICMEM 2022)* (pp. …).

Rouyendegh, B. D., & Erkan, T. E. (2011). *Selecting the best supplier using analytic hierarchy process (AHP) method. African Journal of Business Management, 6*(4), 1455–1462. http://www.academicjournals.org/AJBM

Sahroodi, K., Keramatpanah, A., Amini, S., Shiri, E., Shayad Haghighi, K., & Najibzadeh, M. (2012). *Application of analytical hierarchy process (AHP) technique to evaluate and selecting suppliers in an effective supply chain. Kuwait Chapter of Arabian Journal of Business and Management Review, 1*(8).

Saleh, B. I., Irawan, A., Anwar, C., Abidin, R. Z., & Radyawanto, A. S. (2020). *Analytical hierarchy process for enhancing procurement decision-making in project phase: A case study in the gold mining project. ComTech: Computer, Mathematics and Engineering Applications, 11*(1), 43–56.

Saaty, T. L., & Vargas, L. G. (2012). *Models, methods, concepts & applications of the analytic hierarchy process.* Springer.

Yang, T., Wang, R., Cui, Z., Dong, J., & Xia, M. (2018). Multi-attribute selection of maritime heterogenous networks based on SDN and fog computing architecture. *2018 16th International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks (WiOpt)*. https://doi.org/10.23919/WIOPT.2018.8362876