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DEVELOPMENT OF A TRANSFORMER ASSET MANAGEMENT DASHBOARD IN UPSTREAM OIL AND GAS COMPANIES THROUGH ABC AND FSN ANALYSIS

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Abstract. Upstream oil and gas companies face significant challenges in managing transformer asset data, which is critical to operational efficiency. The complexity of manually handling data and transformer-related information hinders optimal decision-making. This study aims to develop an effective transformer asset management dashboard by applying *FSN* (*Fast-Slow-Non Moving*) and *ABC* (*Activity-Based Costing*) analysis. The research methodology includes identifying system requirements, collecting data through observation and interviews, developing a solution using Microsoft Power BI, and conducting user acceptance testing (*UAT*). The results demonstrate that the dashboard successfully integrates transformer asset data with real-time visualizations, including availability status (2,124 units available, 4,305 units in ready-to-use condition, and 2,181 units not ready), *ABC-FSN* classification (AF 30%, BS 20%, AS 10%, CN 40%), and monthly stock trends. The *UAT* evaluation, conducted with 17 respondents, yielded an average score of 4.5, categorized as highly appropriate across parameters such as functional suitability, usability, performance efficiency, reliability, accuracy, visual design, and user satisfaction. The dashboard's integration with the Microsoft 365 ecosystem enables real-time data access and supports data-driven decision-making, thereby enhancing the optimization of transformer asset management.

Keywords: asset management, transformer, dashboard, Analysis Based Costing (ABC), Fast-Slow-Non Moving (FSN).

INTRODUCTION

The upstream oil and gas industry is a strategic sector that requires reliable electrical infrastructure to support complex operations such as drilling, processing, and distribution. Distribution transformers are among the critical assets that demand the largest investment in this business, playing a vital role in ensuring the continuity of electricity supply for all operational activities (Dawood, Sönmez, et al., 2023; Dawood, Tursun, et al., 2023; Dawood & Komurgoz, 2020; Dawood & Tursun, 2023; Fukumoto et al., 2014; Moradnouri et al., 2019). Globally, the energy industry faces the dual challenges of increasing operational complexity and growing efficiency demands, where effective asset management is key to achieving a balance between system reliability, operating costs, and maintenance expenditures (Kure et al., 2022; Piryonesi & El-Diraby, 2020; Teoh et al., 2023; Zeb, 2017).

Failures in transformers, such as overload, overvoltage, and blackout events, have a significant impact on power supply processes, potentially causing substantial operational losses (Chen et al., 2021; Jena & Meena, 2022; Novak & Janeš, 2019; Prasetyo et al., 2020). In Indonesia, upstream oil and gas companies in Riau face specific challenges in managing transformer inventory asset data to control availability during the outgoing and incoming transformer transaction processes. The existing manual recording system poses various operational risks, including human error, inventory data inaccuracies, slow data retrieval and update processes, and difficulties in auditing and tracking data changes.

The urgency of this research is driven by the critical need to modernize transformer asset management systems, which currently rely on manual logbooks. These manual processes are vulnerable not only to logging errors and data loss but also impede rapid and accurate decision-making in operational contexts that demand immediate response. Limited information accessibility and challenges in cross-departmental data sharing represent significant barriers to effective cross-functional coordination.

Relevant studies highlight the importance of implementing digital systems in asset management. Hudori et al. (2019) developed the *FSN* analysis method for inventory grouping based on the Turnover Ratio, which considers the quantity, consumption level, and frequency of use to optimize inventory management. Shi et al. (2024) investigated demand response-based inventory control methods, demonstrating the effectiveness of a data-driven approach in asset management. Meanwhile, Renaldy and Marcus (2020) applied *Fast-Slow-Non Moving* analysis within purchasing and sales information systems, proving the effectiveness of this classification in supporting operational decision-making.

The novelty of this research lies in the integration of *FSN* (Fast-Slow-Non Moving) and *ABC* (*Activity-Based Costing*) methods in developing a transformer asset management dashboard utilizing business intelligence via Microsoft Power BI. This innovative approach combines the analysis of asset movement frequencies with classification based on investment value to create a more comprehensive and integrated management strategy. Furthermore, the solution is integrated with the existing Microsoft 365 ecosystem within the company, enabling implementation without requiring significant new infrastructure investments.

The primary objective of this research is to develop a transformer asset management dashboard system that enhances data management efficiency, reduces the risk of data discrepancies caused by human error, facilitates access to both qualitative and quantitative information on transformer assets, and supports informed decision-making for procuring new transformer units based on actual usage data. Additionally, this research aims to evaluate the dashboard's utility through a User Acceptance Test (*UAT*) to ensure alignment with the company's operational requirements.

The anticipated benefits of this research include delivering a practical contribution to upstream oil and gas companies by optimizing transformer asset management, reducing operational costs via improved process efficiency, and enhancing the reliability of electricity supply. Academically, it contributes to the advancement of *FSN-ABC* analytical integration methodologies for industrial asset management and the application of business intelligence within the energy sector. In the long term, this research may drive digital transformation in asset management across similar industries, elevate operational standards, and support sustainability through optimized resource utilization.

RESEARCH METHODS

This study uses a mixed method approach with a combination of qualitative and quantitative methods. The research design follows systematic stages starting from identifying system needs, collecting data, developing solutions, to evaluation and implementation. The methodological framework is designed to ensure the systems developed are in accordance with the operational needs and characteristics of transformer asset management in upstream oil and gas companies.

The needs identification stage is carried out through a systematic requirements engineering approach to identify, document, and manage system requirements. This process involves an in-depth analysis of the transformer's existing asset management system, identification of problems, and specifications of new system requirements. The needs identification strategy categorizes transformers based on the level of change: fast-moving (requires rapid iteration), slow-moving (requires medium-term planning), and non-moving (requires stable planning).

Data collection is carried out through two main methods:

1) Observation: Field observations were carried out in the February-March 2024 period to analyze the flow of the transformer asset management process. The observed data included the type of transformer brand, product code (Product Id), warehouse shelf storage location, historical data on the date of goods, status of ready and not ready line usage, and the number of transformers used. Observation includes the analysis of the process of data and information delivery during data processing in a transformer asset management system.
2) Interview: Semi-structured interviews were conducted with 5-10 individuals representing a variety of transformer asset management-related positions, including: Superintendent of Operations & Maintenance (asset planning and control), Maintenance Engineer (preventive and corrective maintenance), Field Technician (implementation of maintenance and repair), and Data Analyst (collection, analysis, and interpretation of asset performance data).

Dashboard development using Microsoft Power BI with a visual approach based on gestalt principles and preattentive attributes. The stages of development include:

1. Extract data from Excel to Power BI
2. Data transformation using Power Query for data cleansing
3. Implementation of DAX (Data Analysis Expressions) formulas for business metric calculation
4. Development of interactive visualizations in the form of dashboards

DAX formula used:

Readyline = CALCULATE([Quantity],Transactions[Transaction Type]="Readyline") (1)

Not Ready = ABS(CALCULATE([Quantity],Transactions[Transaction Type]="Not Ready")) (2)

Quantity = SUM(Transactions[Quantity]) (3)

ABC analysis is carried out based on the cumulative value contribution with the formula:

Cumulative Percentage = (Cumulative number of annual volumes / Total annual volume) × 100% (4)

FSN analysis uses the comparison ratio:

Rasio FSN = Quantity / Reorder Level (5)

The logical architecture consists of 4 layers: databases (Excel in SharePoint), integration and transformation (Power Query), analytics (DAX in Power BI), and visualizations (interactive dashboards). The physical architecture connects Excel and SharePoint through Power BI Gateway to Power BI Desktop and is published to Power BI Service on the Azure Cloud.

The evaluation was conducted using a questionnaire with 7 assessment aspects based on international software quality standards: functional suitability, usability, performance efficiency, reliability, accuracy & data integrity, visual design, and user satisfaction. The assessment uses a scale of 1-5 with the average score formula:
Average Score = Total of all scores from respondents / Number of respondents (6)

The system is deployed using the Microsoft 365 platform with data stored in OneDrive and distributed through SharePoint and Microsoft Teams for real-time access by the entire organization's internals.

RESULTS AND DISCUSSION

Data Collection Results

Transformer Management Inventory Dashboard Visualization Analysis

The implementation of the transformer asset management dashboard results in a comprehensive visualization system that displays the status of transformer unit availability in three key indicators. Based on the DAX formula applied, the total ready line shows 4,305 units of transformers that are ready for use, a total of 2,181 units that are not ready that need repair, and 2,124 units available in actual.

Table 1. Transformer Availability Status

Indicator	Number of Units	Percentage	Status
Ready Line	4.305	66,4%	Ready for Operation
Not Ready	2.181	33,6%	Need Improvement
Quantity Available	2.124	100%	Total Available

A visualization of stock availability trends in 2024 shows a consistent cumulative increase from 2,000 units in January to 25,000 units in December. This pattern of increase indicates the effectiveness of the buffer stock strategy and optimal maintenance activities, where the number of transformers entering stock is greater than the number of transformers that come out every month.

The percentage of available stock shows a value of 49.34% which represents the ratio of the availability of ready-to-use units to the total total units in the system. These results show that almost half of the total transformer units are in a ready state for operation, while 50.66% require attention for reordering or maintenance.

ABC-FSN Classification Analysis

The implementation of the ABC method results in a classification of transformers based on the cumulative value contribution to the total inventory. This classification divides products into three categories with different characteristics.

Table 2. ABC Classification Results

Category	Number of Products	Cumulative Percentages	Management Priorities
A	4	0% - 70%	Height (Strict Control)
B	1	70% - 90%	Medium (Standard Control)
C	4	90% - 100%	Low (Flexible Control)

Category A is dominated by Sierra 150 KVA (100 units), Triputra 300 KVA (90 units), Sierra 300 KVA (89 units), and Trafindo 300 KVA which contribute more than 45% to the total quantity. These products require close supervision due to their significant impact on operations. Category B consists of 300 KVA B&D with a cumulative 72% contribution, while C category includes UNINDO 300 KVA, OSAKA 75 KVA, WELTRAF 500 KVA, and 500 KVA B&D with an individual contribution of less than 10%.

FSN analysis is carried out based on the comparative ratio between quantity and reorder level to determine the movement rate of each transformer product.

Table 3. FSN Classification Results

Category	Ratio Range	Number of Products	Features
Fast Moving	> 1,2	3	High Usage
Slow Moving	0,8 - 1,2	2	Medium Use
Non Moving	< 0.8	4	Low Usage

The combination of the ABC-FSN classification results in the distribution: AF (A-Fast) 30% as the highest priority with high values and fast movement, AS (A-Slow) 10% with high values but slow use, BS (B-Slow) 20% with medium values and slow movement, and CN (C-Non) 40% with low values and inactivity that require further evaluation.

ABC-FSN Matrix Analysis

Table 4. ABC-FSN Cross Matrix

ABC/FSN	Almost	Slow	Not	Total
A	3	1	-	4
B	-	1	-	1
C	-	-	4	4
Total	3	2	4	10

The cross-matrix showed the largest concentration in the C-Non category (4 products) which indicated potential waste or underutilization. The A-Fast category (3 products) requires the highest priority in management due to the combination of high value and fast movement.

Discussion of Classification Results

Implementation of the ABC Method

The results of the ABC classification show an uneven distribution with concentration of values in several key products. Sierra 150 KVA as the product with the highest contribution (100 units) requires special attention in management due to the significant impact on operational continuity. The cumulative percentage of 70% achieved by the first five products demonstrates the effectiveness of the Pareto principle in the context of transformer asset management.

Category A with a contribution of 70% of the total value requires a real-time monitoring system and strict ordering protocols to prevent stockouts. The implementation of just-in-time inventory for this category can optimize cash flow without sacrificing availability. Category B requires a balanced approach between cost efficiency and service level, while category C can be managed with a bulk purchasing strategy and extended review cycles.

FSN Method Implementation

FSN's analysis revealed a varied consumption pattern with 40% of products in the non-moving category, indicating the potential for inventory optimization. Fast-moving products with a > ratio of 1.2 indicate consumption levels that exceed the planning level, requiring adjustments in reorder points and safety stock calculations.

Table 5. Detailed FSN Ratio Analysis

Product	Quantity	Reorder Level	Race	Category	Recommendations
Sierra 150 KVA	100	75	1,33	Almost	Increase Safety Stock
Triputra 300 KVA	90	70	1,29	Almost	Monitor Closely
B&D 500 KVA	10	15	0,67	Not	Review Necessity
WELTTRAF 500 KVA	12	18	0,67	Not	Consider Elimination

The slow-moving category requires periodic review of adjustment reorder parameters, while non-moving products require in-depth analysis to determine whether they are still needed in operations or can be eliminated for space optimization and carrying costs.

Evaluasi User Acceptance Test (UAT)

The UAT evaluation was carried out on 17 respondents representing various levels of positions in the organization. The results of the evaluation show a very high level of acceptance of the developed dashboard system.

Table 6. UAT Evaluation Results

Assessment Aspects	Average Score	Category	Interpretasi
Functional Suitability	4,6	Highly Appropriate	Features as needed
Usability	4,5	Highly Appropriate	Easy to use
Performance Efficiency	4,4	Highly Appropriate	Quick response
Reliability	4,5	Highly Appropriate	Stable and reliable
Accuracy & Data Integrity	4,7	Highly Appropriate	Date just
Visual Design	4,3	Highly Appropriate	Attractive display
User Satisfaction	4,6	Highly Appropriate	High satisfaction
Overall Average	**4,5**	**Highly Appropriate**	**Accepted System**

The highest score was achieved in the Accuracy & Data Integrity aspect (4.7) which indicates that the system successfully addressed the main problem of data inaccuracies in the previous manual system. Functional Suitability and User Satisfaction that reaches a score of 4.6 indicates that the system has met user expectations and is in accordance with operational needs.

Implementation Impact Analysis

The implementation of transformer asset management dashboards has a significant impact on operational efficiency. Reducing data search time from an average of 15 minutes to 2 minutes increases team productivity by 87%. Data accuracy increased from 75% (manual systems) to 98% (digital systems), reducing the risk of decision-making errors.

Table 7. Comparison of Manual vs Digital Systems

Parameter	Manual System	Digital System	Improvement
Data Search Time	15 minutes	2 minutes	87%
Data Accuracy	75%	98%	31%
Update Frequency	Weekly	Real-time	Continuous

Accessibility	Limited	Multi-platform	Universal
Backup Data	Manual	Automatic	Reliable

Integration with the Microsoft 365 ecosystem enables seamless collaboration between departments with increased response time in emergency situations from 2 hours to 15 minutes. Cost savings are estimated to reach 25% of operational costs related to inventory management through optimizing stock levels and reducing emergency procurement.

CONCLUSION

This study successfully developed an effective transformer asset management dashboard by integrating *FSN* and *ABC* methods using Microsoft Power BI, addressing key challenges in upstream oil and gas companies such as manual data inaccuracies, delayed information access, and difficulties in data-driven decision-making. The dashboard significantly improved operational efficiency, reducing data search time by 87%, increasing data accuracy from 75% to 98%, and enabling real-time access that supports rapid decision-making. The *ABC-FSN* classification offered strategic insights by categorizing assets with 30% in the highest priority (AF) group, 20% in BS, 10% in US, and 40% in CN categories requiring further evaluation. User Acceptance Test results showed a high approval rate (average score 4.5), confirming readiness for full deployment. Integration with the Microsoft 365 ecosystem ensures sustainability and scalability without major infrastructure investments, delivering strong value to the organization. Future research could enhance this dashboard by incorporating predictive analytics and machine learning to forecast transformer failures, optimize maintenance, and automate reorder processes based on historical and real-time data. Expanding the system to track environmental and sustainability metrics, such as energy efficiency and carbon footprint, and assessing scalability across other critical assets or industries would further strengthen asset management strategies.

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