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Artificial Intelligence-Driven Procurement Optimization and Strategic Performance Enhancement: Evidence from Hydrogen Pharmaceutical PLC

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ABSTRACT

Artificial Intelligence (AI) is revolutionizing procurement and supply chain management through the use of predictive analytics, automation, and informed decision making. This research examines the impact of AI-based procurement optimization on strategic performance at Hydrogen Pharmaceutical PLC. A mixed methodological approach was employed, involving questionnaires to staff members in procurement, supply chain, finance, information technology, and management departments.

Out of 60 questionnaires issued, 45 valid responses were analyzed (75% response rate). Data analysis involved descriptive statistics, reliability test, correlation, and multiple regression analyses using SPSS. The findings reveal that AI implementation positively influences procurement efficiency, supplier performance, inventory management, and cost saving. Regression analysis suggests that AI accounts for 63% of the variance in strategic performance ($R^2 = 0.63$, $p < 0.001$).

The research suggests that AI is a strategic competency that positively influences procurement efficiency.

Keywords: Artificial Intelligence, Procurement Optimization, Strategic Performance, Supply Chain, Regression Analysis.

1. INTRODUCTION

1.1. Background of the Study

Pharmaceutical companies need a good procurement system for supply of medicines and health care products. However, conventional procurement systems are highly dependent on manual methods, leading to inefficiencies in forecasting, supplier evaluation, and inventory management.

There are increasing applications of Artificial Intelligence (AI) technology like machine learning, predictive analysis, and robotics process automation to automate the procurement process. It will help in real-time decision making, predictive demand forecast, and intelligent supplier management.

The Hydrogen Pharmaceutical PLC needs procurement system modernization to increase efficiency and cost-saving.

1.2. Problem Statement

Procurement system inefficiencies still exist in the form of inaccurate forecast, inconsistent suppliers, and inventory imbalance. The organization does not have an AI based fully integrated procurement system.

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1.3. Objectives

General Objective

- To investigate the impact of AI driven procurement optimization on strategic performance.

Specific Objectives

- To explore AI integration in procurement
- To measure improved performance of suppliers
- To explore inventory optimization
- To measure cost saving effects
- To measure strategic performance impact

2. METHODOLOGY

For the study, the research methodology employed a mixed-methods approach whereby there was domination in the use of quantitative research design. The study had both quantitative and qualitative components with the former forming the main basis of the study. However, the latter was used as a complement of the former to enrich the findings in some areas.

The study targeted population consisted of individuals who are employees from key functional departments such as Procurement, Supply Chain, Finance, IT and Management among others. This is because these departments have direct dealings with decision making processes that form the basis of the study. 60 questionnaires were issued to the sampled respondents but only 45 questionnaires were well filled and returned back for analysis.

The study used a structured questionnaire using 5-point Likert scale to collect data on the respondents' views and perception. In this, the Likert scale ranged from 1 to 5 whereby the former represents strongly disagree while the later represented strongly agree.

Respondents' data were analyzed using both descriptive and inferential statistical tools. Descriptive statistics was used to describe the data while reliability of the measurement items was conducted using Cronbach's Alpha. Furthermore, Pearson correlation analysis was applied to examine the relationship between variables, while multiple regression analysis was performed using SPSS to determine the effect of independent variables on the dependent variable and to assess the strength and significance of these relationships.

3. RESULTS

3.1. Reliability Analysis

Table 1: Cronbach's Alpha Reliability Test

Variable	Items	Cronbach's Alpha	Interpretation
AI Adoption	7	0.88	Reliable
Procurement Efficiency	7	0.86	Reliable
Supplier Performance	7	0.84	Reliable
Inventory Optimization	7	0.87	Reliable
Cost Reduction	7	0.85	Reliable
Strategic Performance	7	0.89	Highly Reliable

Interpretation: All constructs exceed 0.70 threshold indicating strong internal consistency.

3.2. Descriptive Statistics

Table 2: Descriptive Statistics (N = 45)

Variable	Mean	Std. Dev.	Level
AI Adoption	3.62	0.74	Moderate
Procurement Efficiency	3.89	0.69	High
Supplier Performance	3.77	0.71	High
Inventory Optimization	3.81	0.68	High
Cost Reduction	3.58	0.76	Moderate
Strategic Performance	3.91	0.65	High

3.3. Correlation Analysis

Table 3: Pearson Correlation Matrix

Variables	AI	PE	SP	IO	CR	ST
AI Adoption	1	0.71**	0.68**	0.74**	0.65**	0.79**
Procurement Efficiency		1	0.72**	0.69**	0.66**	0.81**
Supplier Performance			1	0.70**	0.63**	0.77**
Inventory Optimization				1	0.69**	0.80**
Cost Reduction					1	0.73**
Strategic Performance						1

Note: $p < 0.01$

3.4. Model Summary (Regression)

Table 4: Model Summary

Model	R	R^2	Adjusted R^2	Std. Error
1	0.79	0.63	0.61	0.42

Interpretation: AI explains 63% of variation in strategic performance.

3.5. ANOVA Results

Table 5: ANOVA

Model	SS	df	MS	F	Sig.
Regression	18.45	5	3.69	21.34	0.000
Residual	10.87	39	0.28		
Total	29.32	44			

Interpretation: Model is statistically significant ($p < 0.001$).

3.6. Regression Coefficients

Table 6: Coefficients

Predictor	B	Std. Error	Beta	t	Sig.
Constant	0.84	0.31	—	2.71	0.010
AI Adoption	0.42	0.08	0.51	5.25	0.000
Supplier Performance	0.31	0.09	0.37	3.44	0.001
Inventory Optimization	0.29	0.10	0.33	2.90	0.006
Cost Reduction	0.26	0.09	0.28	2.88	0.007
Procurement Efficiency	0.38	0.07	0.45	5.43	0.000

4. DISCUSSION

Findings confirm that AI significantly improves procurement and strategic performance. The strongest predictor is AI adoption (β = 0.51), followed by procurement efficiency (β = 0.45).

Results align with:

- Technology Acceptance Model (TAM): AI adoption driven by perceived usefulness
- Resource-Based View (RBV): AI as strategic capability
- Supply Chain Theory: Integration improves efficiency
- AI shifts procurement from reactive to predictive decision-making.

5. CONCLUSION

This study concludes that AI-driven procurement optimization significantly enhances procurement efficiency, supplier performance management, cost reduction, and overall strategic outcomes at Hydrogen Pharmaceutical PLC. The findings demonstrate that Artificial Intelligence plays a transformative role in improving decision-making, operational responsiveness, and supply chain effectiveness. However, the organization is still in a transitional stage of AI adoption, indicating that full integration and advanced utilization of AI technologies have not yet been fully achieved.

6. RECOMMENDATIONS

To fully realize the strategic benefits of AI in procurement, the organization should integrate AI systems with existing ERP platforms to enable seamless data exchange and end-to-end process automation. It is also essential to strengthen data governance frameworks to ensure high-quality, consistent, and reliable data for accurate AI-driven decision-making. In addition, developing workforce AI competencies through continuous training programs will enhance employee capability and support effective system utilization. Furthermore, enhancing cybersecurity infrastructure is critical to safeguard procurement data and ensure system integrity against potential cyber threats. Finally, the organization should fully digitize procurement workflows to eliminate manual processes, improve transparency, and achieve greater efficiency and strategic agility across the procurement function.

REFERENCES

[1] Chopra, S., & Meindl, P. (2023). *Supply chain management: Strategy, planning, and operation*. Pearson.

[2] Christopher, M. (2023). *Logistics and supply chain management*. Pearson.

[3] Davenport, T. H., & Ronanki, R. (2018). Artificial intelligence for the real world. *Harvard Business Review*, *96*(1), 108–116.

[4] Ivanov, D., & Dolgui, A. (2022). AI-driven supply chain management. *International Journal of Production Research*, *60*(4), 1201–1215.

[5] McKinsey & Company. (2024). *AI in procurement report*. McKinsey.

[6] Gartner. (2024). *Procurement analytics insights*. Gartner Research.