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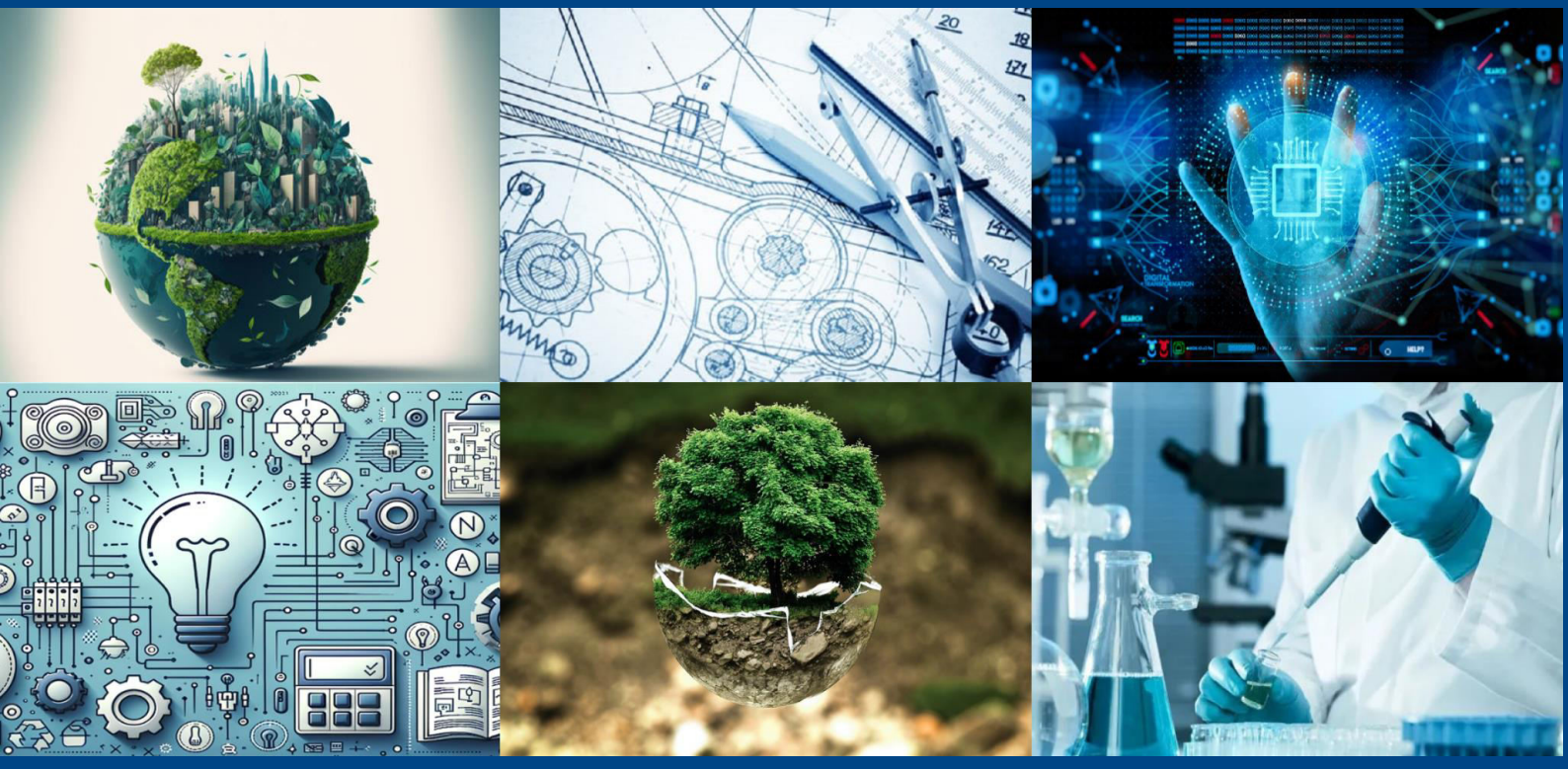

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Campus Chain: A Transparent Budget and Resource Management System with Machine Learning Framework

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ABSTRACT: This study developed Campus Chain, a transparent budget and resource management system with a machine learning framework for improving procurement monitoring at North Eastern Mindanao State University - Cantilan Campus. The study responded to common procurement issues such as delayed processing, limited real-time data, difficulty in tracking expenditures, weak audit trails, and the need for clearer accountability in the use of institutional resources. Campus Chain integrates blockchain technology to provide secure, tamper-resistant, and traceable transaction records, while machine learning supports budget forecasting, anomaly detection, and data-driven resource allocation. The system was developed using the Software Development Life Cycle, covering planning, analysis, design, development, testing, deployment, and evaluation. Its major features include user authentication, dashboard monitoring, transaction viewing, document management, blockchain ledger verification, machine learning prediction, purchase request processing, settings management, and secure logout. The system was evaluated by ten IT experts from NEMSU Cantilan using selected ISO/IEC 25010 quality characteristics. Results showed an overall mean of 4.60, interpreted as Moderately Agree, indicating that the system was generally accepted. Reliability obtained the highest mean of 4.875, while performance efficiency recorded the lowest mean of 4.23. The findings indicate that Campus Chain can support more transparent, secure, and data-driven procurement management.

KEYWORDS: Campus Chain, blockchain, machine learning, procurement management, resource management, ISO/IEC 25010.

I. INTRODUCTION

The procurement process at NEMSU Cantilan continues to face concerns related to transparency, efficiency, and accountability, especially in managing budgets and institutional resources. Delays, limited real-time data, and difficulty in tracking expenditures make it challenging for administrators to monitor procurement activities and make timely decisions. These concerns are most evident in the procurement office, where accurate and transparent resource management is essential.

Campus Chain was proposed as a transparent budget and resource management system with a machine learning framework. The system integrates blockchain technology to secure procurement records and machine learning to support forecasting, anomaly detection, and better resource planning. Through these technologies, the study aims to improve procurement monitoring, strengthen accountability, and support more transparent management practices.

The study specifically aimed to design an efficient resource management system, develop a machine learning-based forecasting component, implement the forecasting algorithm at NEMSU Cantilan, and evaluate the system using selected ISO/IEC 25010 quality characteristics. The system focuses on procurement transactions, financial monitoring, resource allocation, and decision support within the campus context.

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II. LITERATURE SURVEY

Related literature shows that artificial intelligence, blockchain, and cloud computing are increasingly used to improve governance, transparency, and institutional service delivery. Alkhaldi (2024) noted that emerging technologies can make operations more efficient, accessible, and responsive, while Bello et al. (2024) emphasized the value of integrating machine learning and blockchain for real-time fraud detection and secure records.

Several studies support the use of blockchain for transparency and accountability. Mamayson (2025) examined blockchain-based budget transparency in the Philippines, while Hugo et al. (2024) proposed a private blockchain-based procurement and asset management system with QR codes. These studies show that blockchain can improve traceability, security, and trust in financial and procurement processes.

Machine learning is also useful in financial and resource management. Santiago et al. (2025) demonstrated that predictive analytics can improve fund allocation, while Farinde (2025) emphasized the use of forecasting for resource optimization. Together, these studies support the development of Campus Chain as a practical system for improving procurement transparency, budget monitoring, anomaly detection, and data-driven resource allocation at NEMSU Cantilan.

III. METHODOLOGY / APPROACH

The study followed the Software Development Life Cycle (SDLC) approach in developing the Campus Chain system. The process included planning, analysis, design, development, testing, deployment, and evaluation. This approach ensured that the system was organized, functional, and aligned with the needs of NEMSU Cantilan.

Input-Process-Output Framework

The input consisted of local procurement records, historical procurement data, and resource allocation information from NEMSU Cantilan. The process involved data collection, identification of procurement inefficiencies, blockchain-based secure recording, and machine learning-supported resource allocation. The expected output was Campus Chain, a transparent budget and resource management system with a machine learning framework.

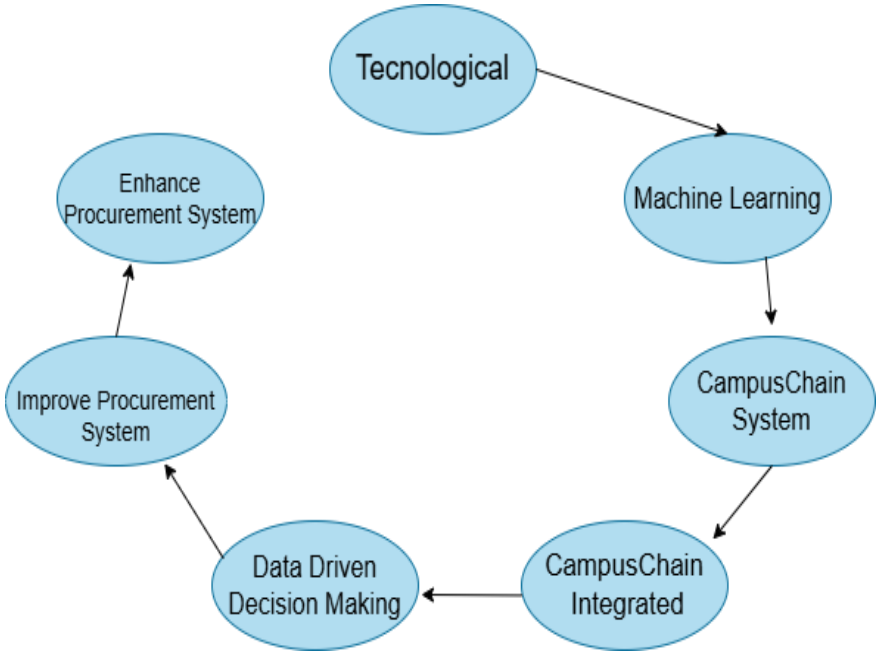

Figure 1 IPO Diagram

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Figure 2 Agile Method

System Development Approach

The researchers used an Agile-oriented SDLC approach because the project required continuous feedback and improvement. The major phases included planning, system design, development, and deployment. During development, modules for transaction recording, blockchain verification, machine learning prediction, dashboard visualization, document management, procurement request processing, and user settings were implemented.

IV. RESULTS AND DISCUSSION

System Overview

Campus Chain presents the overall operation of the proposed blockchain and machine learning framework in improving procurement management at NEMSU Cantilan. The developed system integrates procurement records, historical financial data, and departmental budget allocations into a centralized platform. These inputs are processed through data collection, validation, blockchain-based secure storage, and predictive analysis using machine learning techniques.

The system was able to detect anomalies, predict financial trends, and generate real-time insights for procurement operations. These functions allowed procurement officers and administrators to identify irregular transactions, monitor expenditures, anticipate future financial needs, and make faster decisions based on updated data.

Respondents of the Study

Table 1 Respondents of the Study

Respondents	Affiliated Institution	No. of Respondents
IT Expert	NEMSU Cantilan - DCS	10
Total No. of Respondents		10

The respondents were ten IT experts from the Department of Computer Studies at NEMSU Cantilan. They were selected because they have the technical knowledge and experience needed to evaluate the system in terms of functionality, usability, performance, security, and overall system quality.

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Distribution of Acceptability Level

Table 2Overall Performance Evaluation System Tabulation

Quality Characteristic	Mean	Verbal Interpretation
Functional Suitability	4.28	Moderately Agree
Performance Efficiency	4.23	Moderately Agree
Usability	4.28	Moderately Agree
Compatibility	4.28	Moderately Agree
Reliability	4.875	Moderately Agree
Maintainability	4.78	Moderately Agree
Portability	4.73	Moderately Agree
Security	4.76	Moderately Agree
Overall Mean	4.60	Moderately Agree

The overall acceptability result of Campus Chain obtained a mean of 4.60, interpreted as Moderately Agree. This indicates that the system was generally accepted by the respondents and was considered useful for supporting procurement transactions, document management, blockchain-based tracking, and financial monitoring.

Reliability obtained the highest mean of 4.875. This suggests that the respondents considered the system stable, dependable, available, and capable of maintaining accurate and tamper-resistant records. Performance efficiency obtained the lowest mean of 4.23, which means the system can process transactions and retrieve data efficiently, although further improvement may still be made to increase speed and responsiveness during heavier use.

V. CONCLUSION

The study concludes that Campus Chain successfully met its purpose of improving procurement management at NEMSU Cantilan through blockchain and machine learning technologies. The system addressed major concerns such as limited transparency, inefficient tracking, lack of real-time data, and difficulty in monitoring financial transactions. The evaluation results show that the system was generally accepted by IT experts and was considered functional, usable, compatible, reliable, maintainable, portable, and secure. Although improvement is still needed in performance efficiency and user workflow alignment, the study confirms that Campus Chain can support more transparent, efficient, and data-driven decision-making in procurement management.

Based on the findings, it is recommended that Campus Chain be further improved by optimizing processing speed, simplifying the interface for first-time users, adding mobile access, enabling real-time notifications, and expanding analytics features. Future implementation may also test the system in other offices or departments of NEMSU Cantilan to determine its wider applicability.

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