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System Architecture of Electronic Asset Supply Chain Intelligent Platform for Digital Higher Education

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Abstract

This research aims to design an intelligent platform architecture for electronic asset supply chains for digital higher education and to evaluate the architecture of the intelligent platform for electronic asset supply chains for digital higher education. The sample group consists of evaluations of the intelligent platform architecture for the electronic asset supply chains for digital higher education by experts. These experts assess and certify the appropriateness of the architecture, evaluating the content's suitability and the management processes. The evaluations were conducted by 5 experts who have experience in managing assets in higher education or relevant areas. The research results indicate that the designed intelligent platform architecture for electronic asset supply chains for digital higher education, on average, scored 4.43, which is considered 'good'. The evaluation of its developmental trend from architecture to platform has an average score of 4.80, considered 'very good'. Following that, both the system (Administrators) and the (Webserver and Database Server) evaluations yielded the same average score of 4.60, which is also ranked as 'very good.'

Keywords: electronic asset, supply chain, intelligent platform, digital higher

1. Introduction

Managing supply chains digitally is essential for the administration within educational institutions to promote sustainability and competitive advantage. Therefore, in modern management, there has been a shift towards using information systems to manage various supply chain tasks in higher education institutions. Efficiently using these systems in higher education institutions not only ensures effective leadership in national development but also leverages quality resources to address significant needs (Gopalakrishnan, 2015) and challenges in the country's progress. In tandem with various initiatives for balanced and sustainable national development, modern technology becomes increasingly crucial. This technology, which is contemporary and can meet the fast-paced and precise demands of today's society, plays a vital role (Lertchaiprasert, 2013).

Assets are things under the responsibility of an organization, existing in various forms, both digital and as physical tools and equipment. They are used to establish business relationships, organize activities, and conduct various operations that utilize information and communication technology to achieve the organization's objectives. These assets might be in the form of cyberspace, digital photos, videos, texts, and various electronic media such as websites, online accounts, multimedia data, personal assets, and various electronic devices. Electronic assets in higher education are things under the responsibility of the university, existing in a digital form, to establish business relationships, organize academic activities, and manage various university operations that utilize information and communication technology to ensure the university's operations align with the organization's objectives. These assets might be in the form of cyberspace, digital photos, videos, texts, and various electronic learning media such as websites, online accounts, multimedia data, and personal assets stored digitally, whether on servers, computers, or other electronic devices. These factors allow higher education to manage, develop, and stabilize their organizations, ensuring the provision of educational services, community development, and the creation of innovations beneficial to society (Asmara et al., 2020).

Therefore, to develop an efficient technology system for managing electronic assets within the university and to utilize resources both internally and externally in alignment with the university's mission that bears social responsibility, it's crucial to design the system architecture for accuracy. This will lead to efficient management of assets that enhances, develops, establishes relationships, and fosters an environment that meets societal needs in terms of communication with the society, serving the community, ensuring equal opportunities in accessing higher education, and addressing challenges of disparities within the university and local communities sustainably and effectively.

Research objectives

1. To design the electronic asset supply chain intelligent platform architecture for the digital higher education

2. To evaluate the electronic asset supply chain intelligent platform architecture for the digital higher education

2. Method

2.1 Intelligent platform Architecture with Supply Chain

The architecture of a supply chain system is a tool developed with primary consideration for stakeholders. It should involve other interrelated systems to ensure that the supply chain process is comprehensive and has the least possible impact in every aspect. There should be a sustainable logistics system that efficiently reaches the end user. Factors that arise within the system, such as personnel, systems, equipment, and details at every stage, including manufacturing, transportation, allocation, and broad distribution, should be taken into consideration. Emphasis must be placed on accuracy, security, and the potential of activities. Three main points of concern are the quality of the process, demand forecasting, and mutual trust (Hu et al., 2023).

The architecture of the supply chain system integrates technology. Within the architecture, there must be initiators or manufacturers, products, inventory, retailers, and wholesalers. Retailers determine the price and influence demand and inventory, which in turn affects manufacturers and the production cost. These factors must be in harmony. If there's a desire to develop a smart supply chain, artificial intelligence systems are required. These systems grasp data from external sources to understand potential future impacts (Panket et al., 2022). Additionally, the architecture of the smart supply chain system should be able to predict statuses from various perspectives with accuracy, necessitating the use of vast amounts of data to precisely differentiate relevant details. This results in operational improvements, providing in-depth, actionable insights that add economic value and foster new business ventures (De Giovanni, 2021).

The intelligent supply chain system is a continuous management system where operators utilize real-time data and transportation to enhance efficiency, ensuring transparency, safety, and trust for the logistics customers (Habib & Hasan, 2019). This harmonization is essential for mutual understanding. It's imperative to develop a foundational infrastructure to gain advantages in system development, (Bonatto et al., 2022) especially in smart transportation systems applicable across all transportation modes, such as air, sea, rail, and road. Effective supply chain management must manifest clear requirements, excellent management, and rigorous administrative efforts across all sectors to minimize failures and potential damage. A significant aspect of the supply chain, which should be considered for architectural development, is the uncertainty in demand and the duration of this demand. This is because trends in demand, both surge and decline, can arise from various intricate environmental factors that are unpredictable. Such unpredictability is as challenging as the factors faced by manufacturers, like government policies, regulations, notifications, and directives from respective departments, which can introduce gaps in the entire supply chain management process (Guvenc, 2021).

To develop an efficient supply chain system that aligns with strategic planning and supply chain management objectives involves companies and business activities necessary for design, production, delivery, (Chansamut, 2016) and use of products or services. The supply chain network is a dynamic, non-linear system, encompassing various elements that integrate business activities from transportation, value-addition processes, delivery, to effective supply chain management. This impacts the entire transportation network of an organization, reduces operational risks, and increases profitability. Seeking process efficiency stems from the supply chain's ability to ensure the business's long-term and sustainable survival, flexibility, and enhanced competitiveness. Effective and comprehensive management is facilitated by reliable technological systems (Xu et al., 2022).

The management of supply chain data provides guidelines for managing the supply chain product curve to enhance the efficiency of production processes, reduce losses, reduce imports, and eliminate unnecessary associated components (Khaddam et al., 2020). This is achieved through the application of machine learning, data mining, and appropriate algorithm adjustments to the existing environment. These tools enhance process efficiency, management, and presentation of data valuable for decision-making. The algorithm aims to minimize loss and irrelevant data, adjusting to accurately meet the demands and supply needs. This involves predictive methods to forecast future demands based on current data (AlZu'bi et al., 2022).

The processes within the supply chain involve managing capabilities in evaluating the balance between flexibility focused on decisions related to procurement volume, duration, and reliability. The aim is to reduce risks in procurement and enhance competitive advantage. (Tsai & Lu, 2013) This involves integrating automation technology and existing transportation systems to improve and adjust process models, elevating better management practices and maximizing benefits (Martin Rubio & Andina, 2018). The incorporation of electronics technology aids in supply chain management and automated technologies, enabling users to confidently interpret and accept data, increasing the chances for stakeholders and ensuring sustainability in the supply chain processes (Zhang, 2021).

Supply chain management has become a popular approach for organizations aiming to improve efficiency, reduce costs, enhance responsiveness, (Steve LeMay et al., 2015) and elevate service levels, while also facilitating reliable decision-making processes. Collaboration, information sharing, and agility in various dimensions are essential characteristics of supply chain management. In managing the supply chain, integration is vital across all dimensions, fostering a harmonious flow (Gong & Azambuja, 2013). Effective information sharing, and collaboration can provide a holistic view of the supply chain, preventing data distortion, which, in turn, results in diversity, efficiency, trustworthiness, and accuracy essential for organizational management and swift adaptation in today's world. Supply chain integration is technically challenging due to the many variables involved, emanating from global economic dynamics and production. With the current landscape, organizational resources are increasingly distributed and diverse, and often disparate. Indispensable supply chain management requires real-time data sharing, swift responses, and agile flexibility (Wang & Yih, 2016). While various modern technologies can cater to these needs, the implementation of diverse intelligent systems and technologies might elevate costs and complexities. Nonetheless, there's an emphasis on integrating supply chains that demand real-time monitoring and cloud services for agility, addressing diverse needs cost-effectively (El Baz & Iddik, 2021). Leveraging intelligent sensing techniques for collecting resource condition data throughout the entire supply chain lifecycle is beneficial for seamless resource adaptation to management platforms (Wiengarten et al., 2015). Using networking protocols for integrating supply chain resources, these resources are virtually modeled as cloud services, offered to users as per their needs, ensuring convenience and meeting diverse demands (Yan et al., 2014).

2.2 Components of Supply Chain Architecture System

The supply chain management system is designed to manage blockchain, combined with IoT devices and machine learning. This system can track the process from manufacturers to end users and supports decision-making from system usage (Guo, 2013). The system consists of participants including manufacturers, distributors, coordinators, and related agencies that must be involved in the process to check conditions and requirements of stakeholders. Important data must be stored and verified by the blockchain to ensure accuracy and efficiency at every point of the supply chain (Venkatadri & Kiralp, 2007). The manufacturers provide the data, quality checks, and requirement checks. Logistics are managed to provide real-time inspection data to know the transportation route, date, time, and delivery location. Hence, each step must check the correctness of every process within the supply chain to gain the trust of the participants in the developed system. The developed system must have efficient real-time access with internet technology for assets or IoT and combined with the blockchain to effectively perceive genuine data, and to establish data trust and transparency. RFID technology is used for contactless communication, which specifies tags and automatically inputs data. RFID has high accuracy in identifying even in non-conducive working environments. In the RFID system, there's specific data that can identify manufacturers and prevent human errors in data collection and ensure data accuracy. Meanwhile, the blockchain ensures that there's no data alteration in the supply chain during data integration between the blockchain and RFID, allowing for a comprehensive data origin check and enhancing security efficiently. Subsequently, data analysis supports the decision-making of the intelligent supply chain system, using machine learning for data analysis in smart systems, such as forecasting demands and data analytics. Machine learning supports decision-making when compared to original data. The developed architecture in the supply chain system must have demand forecasting to balance between demand and supply (Hu et al., 2023).

The integration of information and electronics also showcases the potential of production to balance with demand. Therefore, the incorporation of artificial intelligence will require the creation of a cloud service system for procuring physical equipment that can precisely capture communication data over networks. The requirements arising from artificial intelligence systems heavily rely on the internet and are fed by vast amounts of data passing through sensors to collate all the derived information. The primary application of this artificial intelligence pertains to manufacturing, logistics, and supply chains due to their specific features, which involve independent smart detection and interconnectivity for collaborative functioning, perception, decision-making, and human actions under the influence of environmental materials and system-wide data within the supply chain cycle. In the supply chain architecture, artificial intelligence systems can collaboratively handle data to provide balanced processes, from the beginning to the end. This involves collecting data on production, procurement, transportation, demand, warehousing, marketing, and other information. Subsequently, this data is analyzed using big data technology to enhance future production efficiency and planning. Artificial intelligence technology must also enhance the alignment of operations and logistics effectively. The system aids in smart scheduling and planning, adjusting process parameters aptly, quality improvement analysis, and control, as well as preventive maintenance. It also includes analyzing production costs, estimating, and controlling smart energy consumption by monitoring every process and step to achieve human decision-making efficiency in the supply chain (De Giovanni, 2021).

The key components of architecture in a smart supply chain system must include customer system evaluation with clear improvements. It must monitor products and transportation companies. It is essential to have applications that guarantee the safety and privacy of the user's goods. Even though users may want information about the location of goods and the services provided, security is a primary concern for such system users. There needs to be an enhancement in trustworthiness and security regarding the system, and from other perspectives, to make users feel and consider safety. This should involve maintaining confidentiality, non-disclosure of identity, identity verification, data privacy, and location privacy. This ensures that the management process of each segment in the supply chain is credible and reduces gaps in the overall supply chain management process (Guvenc, 2021).

If the components of the supply chain are to be developed into a system, there must be transparency in the production system, distribution, and transportation to the destinations that meet the end customer's needs. Conversely, the tracking control system must have automatic feedback to use data for multi-tier supply chain analysis, to examine potential impacts. Repeated processes are inspected to reduce costs and obtain data for accurate forecasting. In developing a supply chain system, algorithms are essential for linking the current supply chain processes that respond to end user needs and quickly design products that match those needs or provide humans with fast, accurate, and correct decision-making information. A complete supply chain component typically consists of six parts: raw material suppliers, manufacturers, distributors, retailers, end customers, and logistics services. Important activities in the supply chain include the retail section providing information, developing order plans by assessing potential end-customer needs, and delivering them correctly. Distributors can source products for retailers or sellers from their warehouses and send orders to upstream manufacturers. Every part must be responsive to each other. In the upstream process, a program is created to display requirements. Afterward, decisions can be made to plan and purchase raw materials or equipment appropriately (Xu et al., 2022).

The architecture of a developed supply chain system must include groups of manufacturers, sellers, storage warehouses, and recipients. It is essential to link existing data and analyze it under appropriate environmental conditions. The system must be flexible and have sufficient storage sources to meet the requirements of the recipients. Artificial intelligence technology is used to assist in the analysis and collection of data from stakeholders appropriately (AlZu'bi et al., 2022).

The structure and architecture of the supply chain system are tailored to fit and can be improved under the environmental conditions of the supply chain, derived from data analysis and overall supply chain situations based on reliable data, such as manufacturer data, distributor data, transportation data, and end-user data. In the architecture of the supply chain, it identifies the initial activities and the origin of processes, procurement, support, and activities that occur in the supply chain must be in real-time. Therefore, the organization and its ability to coordinate and reflect management visibility will be prominent in the activities of each process. It's necessary to use a large amount of data in management for accuracy in forecasting through network systems and to minimize errors in the process by providing a platform through cloud technology, data storage, data analysis, including forecasting, and financial promotion to support the decisions of each party correctly, efficiently, benefiting stakeholders sustainably (Zhang, 2021).

The architecture of the intelligent supply chain currently integrates various technologies. It synergizes cloud computing and the Internet of Things (IoT) for object connectivity to develop and manage applications in various supply chain perspectives. This ensures precise, real-time physical resources. In the initial phase of cloud processing, everything is considered a service. Each service involves different resource management and processing, offered as Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). Under the foundational structure of these services, supply chain management architecture needs to be flexible by simulating resources and choosing the best logistics services for feasibility and logistics system efficiency. Since data collected by various sensors is increasingly vast and complex, traditional database software tools for storing, managing, and analyzing data will need to process big data. Managing the supply chain with the integration of the Internet of Things and cloud technology manages resources distributed to suppliers, warehouses, transportation, and other areas as services and dynamic coordination. Key components in smart supply chain management must be integrated under a supply chain management platform filled with services in the form of personal clouds, supplier clouds, manufacturing clouds, warehouse clouds, and logistics clouds. It's essential to recognize supplier cloud systems for supply chain management, warehouse cloud servers as a service management platform. The warehouse operates in a distributed manner, serving resources and offering various cloud service formats. In cloud logistics systems, they need to be linked to service providers and recipients, managed by an intelligent platform. The platform for managing the smart supply chain consists of supplier management, logistics management, customer management, and warehouse management, which includes inbound warehouse management, shelf management, outbound warehouse management, and storage management. Each module of the platform requires the intelligent supply chain to have virtual simulations and consolidate various service data for perception, and users can access diverse data as needed. The process uses smart recognition technology to gather essential data for supply chain management. Popular sensing technologies used in intelligent systems include RFID, embedded technology, barcodes, and sensor technology. For the vast amount of data processing, it is collected by the perception module under the conditions of the analytical tool process. Traditional data analysis methods cannot meet the demand, so there is a need for the integration of various technologies to help process the new data efficiently. Instead of the old database, to improve data processing capabilities, the Hadoop framework is popular for storing and analyzing the distribution of large data, enhancing the ability to process and improve data as perceived by various technologies effectively. The appropriate supply chain management process has a total of four steps. The first step is to analyze the resources used to classify physical resource types specific to the supply chain process. The second process is to create a model to describe resources and display resource information such as basic features and operational characteristics. The next step is to use the web language related to the ontology for services (OWLS) to describe the resources occurring in the system. The fourth step is an appropriate format used for platform services (Yan et al., 2014).

Platform architecture connects the relationships of sub-systems and various ecosystems. It's divided into multiple functional parts as follows: The mobile device architecture section involves designing the User Interface (UI) to be visually accessible to users. It displays both input and output data formats, with appropriately designed screen segments. Moreover, there's a data model responsible for processing data, transforming various data for access to the database. Subsequently, there's the application Utility. The next connecting part is the server-side service. It's designed to serve as an intermediary for access and has a data processing unit to access various databases in the server through secure and reliable software libraries. Data Persistence imports files for storage on the database (Kuandee et al., 2019).

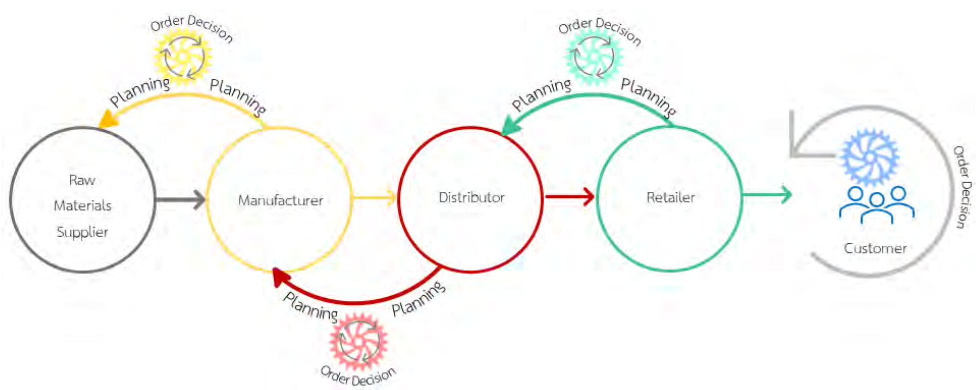

Figure 1. Supply chain process

From synthesizing the elements of architecture in a system with a supply chain, it can be concluded that the development steps of a supply chain management system architecture must have transparent scrutiny for every process and cannot be arbitrarily changed, especially regarding safety and enhancing trust in coordination amongst all stakeholders. Thus, electronic devices are necessary to aid in managing the application of artificial intelligence in architecture, considering the quality and reliability of the stakeholders, and providing real-time information in large quantities. Machine learning models are utilized to predict stakeholder needs and potential prediction errors using deep learning models of Bidirectional Short-Term Memory and Long-Term Memory. Ultimately, an intelligent supply chain management system can adjust requirements and accuracy in other parts of the supply chain in terms of demand management, safety, and supervision, using Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). Essential services underpinning supply chain management must be integrated under a supply chain management platform enriched by services in personal cloud, supplier cloud, manufacturing cloud, warehouse cloud, and logistics cloud formats. The first step is to analyze resources used to classify specific physical resource characteristics in the supply chain process. The second step is to create models to describe resources and display resource information, such as basic attributes and operational characteristics. The subsequent step involves using the Web Language related to Ontology for Service (OWLS) to describe resource services occurring in the system. The fourth step concerns the appropriate format for services through the platform. Thus, platform architecture must be designed for Application Design, Application Utility, User Interface Graphics, User Interface Input, User Interface Output, and User Interface Structure. However, only the Application Design, the Application Utility, and the User Interface Graphics influence consumer behavior.

2.3 Digital Higher Education

The importance of digital transformation in higher education is crucial for maintaining competitiveness, improving services, and meeting the needs of stakeholders. Key points for improvement include the development and enhancement of digital strategies. The term " Digital Higher Education " in this context refers to the transformation of traditional higher education into digital ones. This transformation is discussed with reference to studies conducted by experts in economics and services, which analyze the use of digital technology and electronic learning. Research results show that, while many higher educations have developed their data infrastructure, only a few are appropriately structured for the use of digital technology. Additional technological factors that need to be considered in the digital transformation include developing a digital strategy in line with customer needs, creating transparent university management systems, and establishing open communication with all parties associated with the university in various appropriate formats (Berdykulova et al., 2020).

Digital higher education is a transformation of the university's potential, aiming to develop the university according to the necessity for accepting digital change. This is to improve quality in various areas, enhance economic efficiency, provide flexibility to stakeholders, and reduce various university obstacles. The study explores factors that contribute to these changes in higher education, such as labor shortages and the impacts of operations to provide convenience. The goal is to differentiate between the Digital higher education and traditional university models. It also includes establishing good relationships to create a comprehensive network and respond sustainably to the various needs of the university (Azarov & Shaposhnikov, 2022).

Digital higher education emphasizes the importance of transitioning to digital in higher education to enhance efficiency and competitiveness. The focus is on the lack of universal standards and the integration of information and services, which are obstacles to university development. The aim is to digitize research processes and reduce the complexity of research activities. Understanding the objectives and benefits of digitization in research activities is crucial. This is presented through analysis methods and model building. Specifications for digital services are defined, including process transparency, standardization, and rapid access to information. The advantages of university management and the prerequisites for the successful application of information systems cover the establishment of IT service standards in the research department of digital higher education. (Iliashenko et al., 2020).

Digital higher education represents a transformation in the management style and digital services of higher education institutions in the BRICS countries. There needs to be a creation of a model that aligns with the environment of the traditional higher education, integrating information technology to transition from traditional university formats to digital ones, which is one of the general digital standards. This would involve general digital management and services, and the technical environment system of the organization to promote coordination among various educational institutions. The objective is to ensure that higher education are adequately prepared to respond to the challenges of the changes that occur. This encompasses a comprehensive environment system of digital tools and services, as well as a full-circle standard of digital capabilities and various services of the university leading to becoming a Digital higher education (Pazos et al., 2020).

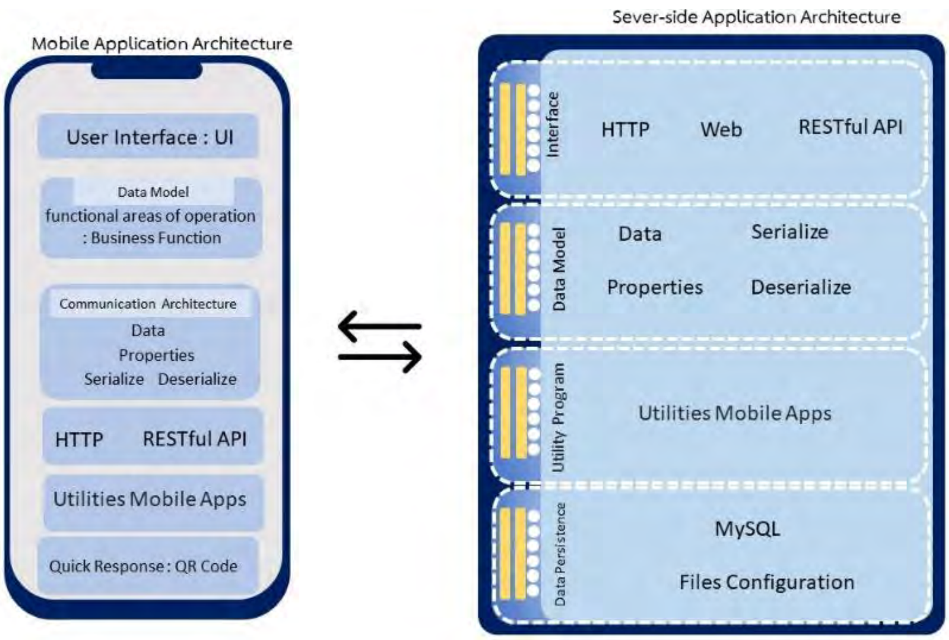

Figure 2. The data exchange process between the Mobile Application Architecture and the Server-Side Application Architecture

The data exchange process between the Mobile Application Architecture and the Server-Side Application Architecture uses a method of communication through QR codes. The QR codes are affixed to equipment or objects that need to be assigned a specific number or code. Inside the QR, data is stored to pull up and display details about the equipment with various specifics to that particular item. When using a smartphone that has the SH2U Application installed and scans the QR Code, it will send data to display the results on the smartphone's screen. This is the part where the user will see all the information and save the data and further process it in the central system.

3. Results

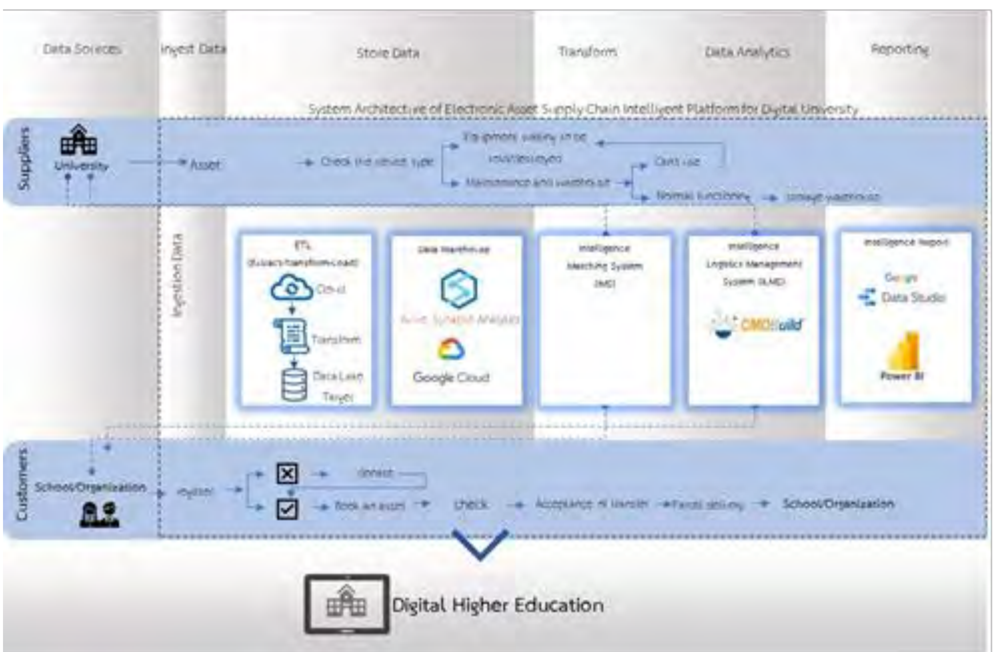

Figure 3. System Architecture of Electronic Asset Supply Chain Intelligent Platform for Digital higher education

The architecture of a smart supply chain platform for digital higher education electronic assets consists of the "Suppliers" section, which represents the higher education, "Customers" being schools or communities, and "Consumers" representing the local community. All these are part of "Data Sources". This data is then forwarded to "Ingest Data" to be stored in the "Data Lake" for future processes. At the same time, customers register on the platform and move to the "Store Data" section, which consists of the data store ID and the data store name or filename. Subsequently, the data from the past to the present is analyzed, interpreted, and the results are summarized for decision-making and accurate reporting.

Table 1. Evaluate system architecture of electronic asset supply chain intelligent platform

No.	**Assessment items**	Mean	**Standard Deviation**	**Appropriateness Level**
1	Administrators	4.60	0.55	Very good
2	Users	4.40	0.55	good
3	Web Application	4.40	0.55	good
4	Hardware Identify	4.20	0.84	good
5	Reports	4.00	0.00	good
6	Webserver and Database Server	4.60	0.55	Very good
7	Data exchange process between the Mobile Application Architecture and the Server-Side Application Architecture	4.40	0.55	good
8	The assessment of the trend in development from architecture to platform	4.80	0.45	Very good
	Total mean	**4.43**	**0.50**	**good**

The evaluation results of the architecture for the smart supply chain platform for electronic assets for digital higher education, as reviewed by experts, have an average score of 4.43, which is rated as "Good". The assessment of the trend in development from architecture to platform has an average score of 4.80, rated as "Very Good". Following that, the evaluations for the system administrators (Administrators) and the web server and database server (WebServer and Database Server) both received the same score, with an average of 4.60, rated as "Very Good". This is consistent with the research of (Yan et al., 2014) where the system is designed to support multiple functions to achieve goals by means of integration and intelligent supply chain management to facilitate resource sharing. Effectively in order to create flexibility in operations, intelligent technology is used to help and reduce risks in management. All data is recorded and processed at a central system in the system with a section that identifies the person who has it. Stakeholders and is consistent with the research of (Kuandee et al., 2019) that includes the concept of supply chain management and intelligent technology to manage consistent demand. In addition, there is an evaluation of the efficiency of the developed system architecture with a management section. Managed the design of the data exchange section in the system through intelligent technology and found that the evaluation results were at a very good level.

4. Discussion

The development of the intelligent platform architecture for electronic asset supply chains for digital higher education necessitates the design of both Mobile Application Architecture and Server-Side Application Architecture for seamless data exchange. This ensures that users can view and store data on their smartphone screens and process it in the central system. The architecture should specify all stakeholders, from the higher education to the end-users, who interact via the intelligent platform based on their respective needs. This approach offers flexibility to all parties involved and minimizes challenges and obstacles faced by higher education. It is essential to adapt to the changing factors within the university environment and to incorporate transparent technological processes that adhere to standards, ensuring swift access to data and facilitating efficient university administration. This is consistent with the research of (Yan et al., 2014) where the system is designed to support multiple functions to achieve goals by means of integration and intelligent supply chain management to facilitate resource sharing. Effectively in order to create flexibility in operations, intelligent technology is used to help and reduce risks in management. All data is recorded and processed at a central system in the system with a section that identifies the person who has it. stakeholders and is consistent with the research of (Kuandee et al., 2019) that includes the concept of supply chain management and intelligent technology to manage consistent demand. In addition, there is an evaluation of the efficiency of the developed system architecture with a management section. Managed the design of the data exchange section in the system through intelligent technology and found that the evaluation results were at a very good level.

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Authors contributions

Mr.Denchai Panket is responsible for research, design, and data collection. Improved data, drafted manuscript, and edited. Assoc.Prof.Dr.Panita Wannapiroon provided advice on designing research tools and Prof. Dr. Prachyanun Nilsook provided advice on research methods, all of which equally helped to improve and support this research.

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Competing interests

Title: System Architecture of Electronic Asset Supply Chain Intelligent Platform for Digital Higher Education has no financial interests or personal relationships that could have appeared to influence the work reported in this article.

Informed consent

Obtained.

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The Publication Ethics Committee of the Canadian Center of Science and Education.

The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

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Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.

References

AlZu'bi, S., Aqel, D., & Lafi, M. (2022). An intelligent system for blood donation process optimization - smart techniques for minimizing blood wastages. *Cluster Computing, 25*(5), 3617-3627. https://doi.org/10.1007/s10586-022-03594-3

Asmara, T. T. P., Abubakar, L., & Handayani, T. (2020). Digital Assets: The Idea of Indonesian Property Law Reform and Its Potential as a Collateral Object. *Hasanuddin Law Review, 5*(3), 278. https://doi.org/10.20956/halrev.v5i3.1735

Azarov, V. N., & Shaposhnikov, S. O. (2022). *Digital University - University 4.0. Proceedings of the 2022 International Conference "Quality Management, Transport and Information Security, Information Technologies"*. IT and QM and IS 2022. pp. 21-25. https://doi.org/10.1109/ITQMIS56172.2022.9976533

Berdykulova, G., Ipalakova, M., Kamysbayev, M., & Daineko, Y. (2020, September 14). *Towards digital university: Experience of kazakhstan.* ACM International Conference Proceeding Series. https://doi.org/10.1145/3410352.3410793

Bonatto, F., Resende, L. M. M. de, & Pontes, J. (2022). Supply chain governance: a conceptual model. *Journal* *of Business and Industrial Marketing, 37*(2), 309-325. https://doi.org/10.1108/JBIM-09-2019-0418

Chansamut, A. (2016). ICT System in Supply Chain Management for Research in Higher Education Institute. *University of the Thai Chamber of Commerce Journal Humanities and Social Sciences, 36*(2), 210-221. Retrieved from https://so06.tci-thaijo.org/index.php/utccjournalhs/article/view/187087

De Giovanni, P. (2021). Smart Supply Chains with vendor managed inventory, coordination, and environmental performance. *European Journal of Operational Research, 292*(2), 515-531. https://doi.org/10.1016/j.ejor.2020.10.049

El Baz, J., & Iddik, S. (2021). Green supply chain management and organizational culture: a bibliometric analysis based on Scopus data (2001-2020). *International Journal of Organizational Analysis, June.* https://doi.org/10.1108/IJOA-07-2020-2307

Gong, J., & Azambuja, M. (2013). *Visualizing construction supply chains with google cloud computing tools.* ICSDEC 2012: Developing the Frontier of Sustainable Design, Engineering, and Construction - Proceedings of the 2012 International Conference on Sustainable Design and Construction. pp. 671-678. https://doi.org/10.1061/9780784412688.080

Gopalakrishnan, G. (2015). How to apply academic supply chain management: The case of an international university. *Management (Croatia), 20*(1), 207-221.

Guo, F. (2013). Study on green intelligent supply chain cost management in manufacturing engineering. *Applied Mechanics and Materials, 340*, 230-234. https://doi.org/10.4028/www.scientific.net/AMM.340.230

Guvenc, O. (2021). *A Comprehensive View of Intelligent Transport Systems and Supply Chain Management for CIS Countries.* International Conference on Vehicle Technology and Intelligent Transport Systems, VEHITS – Proceedings. pp. 611-617. https://doi.org/10.5220/0010472906110617

Habib, M. M., & Hasan, I. (2019). Supply Chain Management (SCM) - Is it Value Addition towards Academia? *IOP Conference Series: Materials Science and Engineering, 528*(1). https://doi.org/10.1088/1757-899X/528/1/012090

Hu, H., Xu, J., Liu, M., & Lim, M. K. (2023). Vaccine supply chain management: An intelligent system utilizing blockchain, IoT and machine learning. *Journal of Business Research, 156*. https://doi.org/10.1016/j.jbusres.2022.113480

Iliashenko, O., Shestakov, G., Iliashenko, V., & Zotova, E. (2020). Formation of requirements for IT services of a research department at a digital university. *IOP Conference Series: Materials Science and Engineering, 940*(1). https://doi.org/10.1088/1757-899X/940/1/012144

Khaddam, A. A., Irtaimeh, H. J., & Bader, B. S. (2020). The effect of supply chain management on competitive advantage: The mediating role of information technology. *Uncertain Supply Chain Management, 8*(3), 547-562. https://doi.org/10.5267/j.uscm.2020.3.001

Kuandee, W., Nilsook, P., & Wannapiroon, P. (2019). Asset supply chain management system-based IoT technology for higher education institutions. *International Journal of Online and Biomedical Engineering, 15*(3), 4-20. https://doi.org/10.3991/ijoe.v15i03.8533

Lertchaiprasert, P. (2013). Study of e-Waste Management with Green ICT in Thai Higher Education Institutions. *International Journal of E-Education, e-Business, e-Management and e-Learning.* https://doi.org/10.7763/ijeeee.2013.v3.231

Martin Rubio, I., & Andina, D. (2018). Smart Manufacturing in a SoSE Perspective. *Advances in Renewable Energies and Power Technologies, 2*, 479-507. https://doi.org/10.1016/B978-0-12-813185-5.00015-2

Panket, D., Wannapiroon, P., & Nilsook, P. (2022). *A Review Intelligent Supply Chains for Asset Management.* Proceedings - 2022 Research, Invention, and Innovation Congress: Innovative Electricals and Electronics, RI2C 2022. pp. 347-352. https://doi.org/10.1109/RI2C56397.2022.9910293

Pazos, A. J. B., Ruiz, B. C., & Pérez, B. M. (2020). Digital transformation of university teaching in communication during the covid-19 emergency in spain: An approach from students' perspective. *Revista Latina de Comunicacion Social, 2020*(78), 265-287. https://doi.org/10.4185/RLCS-2020-1477

Steve LeMay, Helms, M. M., Kimball, B., & McMahon, D. (2015). Supply chain management: the elusive concept and definition Key. *The Eletronic Library, 34*(1), 1-5.

Tsai, C. F., & Lu, S. L. (2013). *An intelligent platform for green forecasting optimization.* Proceedings - 2013

IEEE 10th International Conference on e-Business Engineering, ICEBE 2013. pp. 142-148. https://doi.org/10.1109/ICEBE.2013.22

Venkatadri, U., & Kiralp, R. (2007). *DSOPP: An intelligent platform for distributed simulation of order promising protocols in supply chain networks*. In IFAC Proceedings Volumes (IFAC-PapersOnline) (Vol. 8, Issue PART 1). IFAC. https://doi.org/10.3182/20070523-3-es-4908.00011

Wang, D., & Yih, Y. (2016). *Compatible Supply Chain Management System for Emergency Responses.* https://doi.org/10.1109/GHTC.2016.7857288

Wiengarten, F., Bhakoo, V., & Gimenez, C. (2015). The impact of host country regulatory quality on the value creation process in e-business supply chains. *International Journal of Production Research, 53*(16), 4963-4978. https://doi.org/10.1080/00207543.2015.1008108

Xu, X., Kim, H. S., You, S. S., & Lee, S. Do. (2022). Active management strategy for supply chain system using nonlinear control synthesis. *International Journal of Dynamics and Control, 10*(6), 1981-1995. https://doi.org/10.1007/s40435-021-00901-5

Yan, J., Xin, S., Liu, Q., Xu, W., Yang, L., Fan, L., Chen, B., & Wang, Q. (2014). Intelligent supply chain integration and management based on cloud of things. *International Journal of Distributed Sensor Networks, 2014*. https://doi.org/10.1155/2014/624839

Zhang, Y. (2021). *Application of Data Mining and Fuzzy Location Estimation in Supply Chain Management System*. Proceedings of the 2nd International Conference on Electronics and Sustainable Communication Systems, ICESC 2021. pp. 1978-1982. https://doi.org/10.1109/ICESC51422.2021.9532667