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Blockchain and Digital Transformation of University Asset Management*

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Abstract

As educational activities realize value transmission and value realization through a digital form, the Digital transformation of universities continues to advance. The quantity of asset data continues to grow, with internal value reflected in education, management, and services, while external value is reflected in policies, resources and reputation. Therefore, effective management of university assets is particularly important. Blockchain is an important infrastructure for Digital transformation, which provides a trusted environment for the occurrence of various collaborations and will reshape many collaboration mechanisms. This paper discusses the current situation and problems faced by universities in the process of Digital transformation. We analyze the development opportunities brought about by Digital transformation and the specific problems faced by physical asset management in detail. We discuss the data platform optimization, asset data application, digital asset security, planning strategy, and construction path of digital transformation involved in the physical asset management of universities.

Keywords

Blockchain, Asset Management, Digitization

1. The Connotation of Asset Digitization

Economics believes that assets refer to resources formed by past transactions or events of enterprises and institutions, owned or controlled by the unit, and expected to bring economic benefits to the unit. The three major components of assets include economic value, measurable value, and ownership.

Asset digitization refers to the process of converting physical world assets into

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digital form and mapping them into digital space. It is the process of converting physical assets into binary digits of the virtual world. The main purpose of asset digitization is to improve the value exchange process of physical assets and facilitate transactions. In a sense, asset digitization has not created new assets [1].

From the perspective of value creation process, asset digitization has not changed the original way of realizing asset value, and its existence relies on existing assets in the physical world. After mapping physical assets to the digital world, the existing form of credit relationship changes, but the intrinsic value and use value of assets remain unchanged [2].

The digitization of assets mainly includes three steps:

1) Confirmation of rights

In the era of digital finance, the public and private key system poses a huge challenge to the traditional account system, and authentication no longer needs to be completed through the account system. Users can register their assets through digital identity, and complete the initial confirmation of digital assets after being unanimously recognized by all users in the distributed network.

2) Digitization of asset native information

In the process of digitizing assets, the underlying information of assets is synchronously digitized and automatically updated over time, resulting in a significant improvement in the efficiency and authenticity of information disclosure, and an increase in the autonomous liquidity of underlying assets. The automation and transparency of information disclosure mechanisms have reduced the cost of information search for market participants, making them more friendly to small and medium-sized financiers [3].

3) Smart contract

The transaction mode of digital assets will undergo profound changes. Both parties can write the pre agreed contract terms into smart contracts, and automatically deliver and transfer assets when conditions trigger. The transaction process does not require third-party intervention, which can effectively reduce supervision costs.

The digitization of assets will reshape the operation of the financial market, allowing a large number of traditional non-standard assets to enter the financial market and circulate among investors at a low cost, which will lead to a revolution in the financial industry and promote the establishment of a digital financial system [4].

2. The Current Situation of Digital Management of University Assets

2.1. The Necessity of Digital Asset Management

Asset management is one of the core tasks of universities, and its implementation directly affects operations and development. Therefore, it is necessary to increase investment in infrastructure, establish a professional work team, and guide management personnel to learn new technologies, models, and methods.

Based on this, work content and responsibilities are refined to ensure the safety of asset management. At the same time, it is necessary to deeply implement various mechanisms and measures in the management process, update advanced technology and supporting facilities, timely identify and handle problems, effectively reduce the difficulty of asset digital management, and ensure that asset digital management works can play a practical role [5].

1) Ensuring asset security

In the new situation, universities should digitize their asset management work, increase investment with the pace of innovation and development, manage assets in new forms, and cooperate with modern technology to obtain more accurate and complete information data, further improving the overall practical effectiveness. In practical work, specialized management and technical teams should be established to provide guarantees in various aspects such as human, material, and financial resources. Through innovation, the requirements of asset information management should be met. At present, enterprises need to analyze and record the execution aspects, summarize the information generated in each link, identify and handle problems in a timely manner through analysis, in order to bring a positive impact on the improvement of asset security [6].

2) Simplify asset management processes

The traditional management method is mainly manual, which often hinders the improvement of management effectiveness due to human factors. In this regard, blind investment or innovation cannot be achieved, and management work needs to be fully implemented. A detailed analysis of the current implementation of digital management of university assets should be conducted, and a sound management mechanism and measures should be developed to play a regulatory role and improve the effectiveness of operations (as shown in **Figure 1**). At the

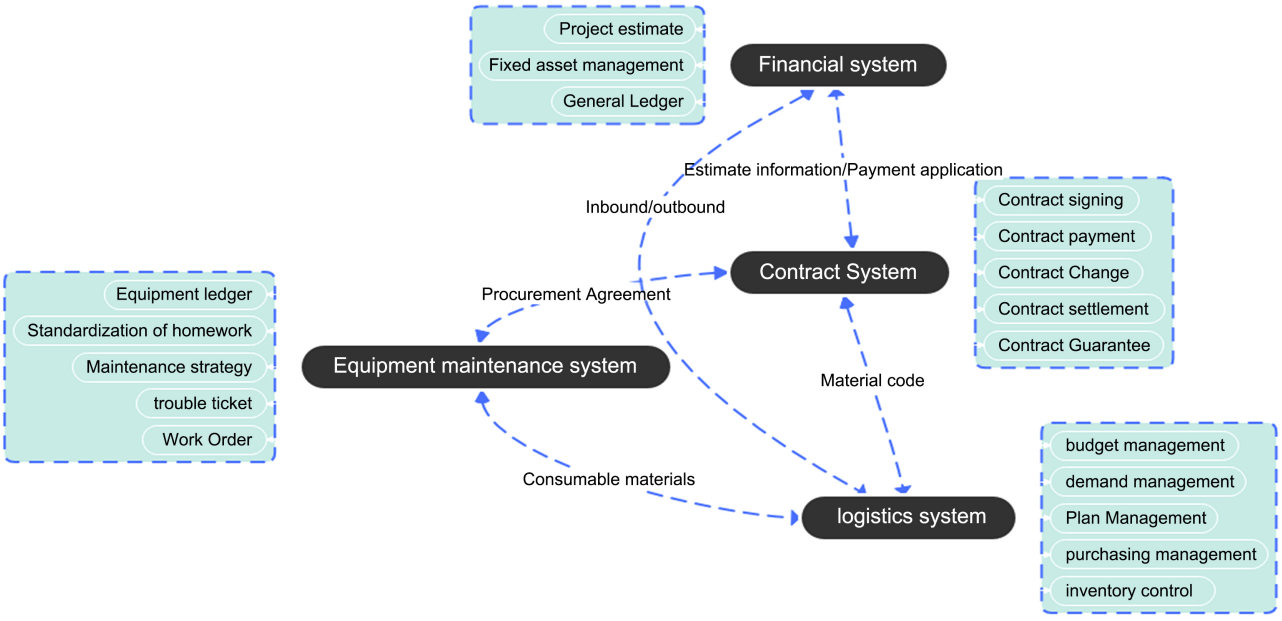

Figure 1. Integration of core information systems.

same time, the work content and responsibilities of each department need to be continuously refined, adopting a refined management model reasonably, simplifying the asset management process, emphasizing the standardization of asset digital management work based on work content and responsibilities, and always emphasizing the accuracy and completeness of information data. On this basis, it is necessary to increase the training and assessment of personnel, continuously enhance their collaboration awareness, and through cooperation and configuration, ensure that each link has independent and professional staff, effectively eliminate hidden dangers and risks, avoid obstacles to the subsequent work, and optimize the management process with the innovation of the asset management system, to play the practical role of digital asset management [7].

3) Save management costs

The development of digital management requires a large amount of investment in the process of system creation and innovation. Some universities are eager to verify this and invest heavily without purpose or basis. This not only causes an imbalance in investment funds, but also affects the innovation of other work. In terms of infrastructure, software and hardware updates, it is necessary to keep up with the development pace of the information age, implement dynamic tracking and management of asset digital management, set up dedicated personnel, specialized management, and special mechanisms based on current development needs, and pay attention to details when preparing plans and plans, so that innovation and management work can be carried out in an orderly manner. On this basis, by cooperating with the digital management of enterprise assets, the usage of each fund is recorded in detail, and the interaction, sharing, and application of information resources between departments are utilized to improve resource utilization and meet the needs of digital management of enterprise assets [8].

In addition, various ways and means should be utilized to comprehensively promote and enhance the awareness and ability of asset digital control, providing a foundation for various activities such as administrative work, scientific research, and enterprise development. At the same time, we should adhere to the idea of "everyone participating", enhance the initiative of employees, leverage our own advantages and abilities, create a good work atmosphere, continuously optimize management processes, maximize the protection of the rights and interests of all parties in accordance with laws and regulations, ensure that asset management work is legal and rule-based, thereby improving the responsibility, ability, and operational level of asset management personnel, and enhancing the asset management efficiency of the enterprise, Ultimately, it becomes the main driving force for promoting stable development [9].

2.2. Issues in University Asset Management

1) Defects in regulatory systems

University asset management started relatively late and still lacks experience

in practical applications. If it is borrowed or directly applied, it will lead to inconsistent execution with its own development situation, and there will be a lack of global and forward-looking exploration process. There are certain differences in the attributes of university assets. If the management models or methods of other units are directly used, there will be significant risks and hidden dangers, which can lead to unclear division of responsibilities, chaotic management, data loss, and ultimately weaken management capabilities.

Some units have inadequate management mechanisms and discrepancies in terms of job responsibilities and institutional settings with the actual situation. Asset management mainly adopts a financial separation approach, such as the accounting department mainly responsible for physical asset management, but lacks a detailed definition of virtual assets; The Logistics Department is responsible for managing life related assets, administrative office related assets, etc. Due to unclear division of powers among various departments, it is easy for some assets to be left unattended, lacking a comprehensive management mechanism, unclear management boundaries among departments, inadequate implementation of management work, increasing management difficulty, and also causing numerous new management problems [10].

2) Asset safety regulatory deficiencies

Exploring the effectiveness of smart campus construction often results in varying degrees of system failures, data loss, garbled code, and other phenomena when invaded by viruses due to the low emphasis on digital asset management, coupled with insufficient human, material, and financial resources. This makes it difficult to ensure security and poses a serious obstacle to the subsequent management work.

Although some enterprises have invested in digital management platforms and utilized information technology for management, they have not taken into account the interactivity of information data in recording, querying, allocating, and inventory, and there is still room for improvement in dynamic management. At the same time, data-driven management standards lack basis and standardization, presenting a variety of data formats. Whether it is data statistics, reporting, or sharing, they will face a large workload, and relying solely on personnel management will increase basic consumption. Moreover, due to the fact that each department only completes their own work and neglects information resource sharing, they may even shift responsibility to each other when security issues occur, seriously affecting the effectiveness of digital asset management in enterprises [11].

3) Information data interaction defects

Some units still remain at the traditional level of asset management and do not dynamically track asset management work. Moreover, due to the arbitrary division and merger of management agencies, lack of long-term planning, and unclear goals, various resource allocation situations have appeared unreasonable, such as poor work connection and inability to find relevant responsible per-

sons in a timely manner, resulting in some management work being put on hold and unable to promote the sustainable development of asset digital management work [12].

3. The Role of Blockchain in the Process of Digital Transformation

In the digital 2.0 era, it is mainly composed of three General technology, namely, blockchain, Internet of Things, and artificial intelligence. At this stage, the data is the means of production, the Internet of Things and artificial intelligence are the production tools, and the blockchain is the relations of production.

Blockchain is the underlying operating system and upper management charter of the digital world. As a machine for creating trust, it will reshape the collaborative approach of the digital world. At the same time, technologies such as blockchain integration and the Internet of Things will also promote the mapping and efficient circulation of physical assets in the digital world in the era of digital migration, achieving value interconnection [13].

The application of blockchain mainly has three key points: firstly, it is a distributed accounting system, forming a trustworthy digital environment; Secondly, combining the digitization of assets to form an efficient value circulation network; Thirdly, combine smart contracts to create a trustworthy collaborative environment.

The new demand for data sharing and circulation in enterprises and institutions has given rise to structural opportunities in the data service industry. Simply put, it can be summarized as data sharing, asset circulation, and collaborative mechanisms.

In terms of data sharing, the core of Data Services 1.0 is to address the data storage needs of information systems in the context of information technology and business dataization.

The core of Data Services 2.0 is to solve the internal data governance needs of large organizations in the context of the Internet and data capitalization.

The core of Data Services 3.0 is to address the need for cross organizational data element circulation in the context of industry digitization, data element transformation, and ecological data value circulation.

In terms of asset circulation, there is a large demand for asset circulation in both financial and cultural fields.

How finance efficiently serves the real economy is determined by information flow, transaction flow and cash flow.

First of all, for a large number of distributed assets, the traditional cost of relying on people to make due diligence is very high. Now many equipment assets can be connected to the Internet of Things. The Internet of Things, combined with the blockchain, can manage assets in a penetrating way to open up the information flow [14].

Secondly, the integrated feature of blockchain payment and settlement can

improve the efficiency of transaction confirmation and reduce transaction friction.

Finally, cash flow is automatically allocated through blockchain credible proof-of-work and smart contracts to reduce cash flow management costs. Therefore, information flow, transaction flow, cash flow and a series of technologies such as blockchain and the Internet of Things can rapidly improve the efficiency of asset flow, and finance will also become a very important application scenario of blockchain.

In the field of asset management in universities, universities usually have a lot of assets, but due to management difficulties, many universities with high-quality assets have shelved their rights to assets such as charging stations and parking lots, whether it is accounts receivable from their surrounding organizations. Blockchain is an ideal way to solve its development difficulties. Therefore, the combination of blockchain and some new technologies can effectively solve the problems of data sharing and asset circulation.

In terms of collaboration mechanisms, since the introduction of the Internet in the 1990s, a large number of self-organization processes have been accelerating, and blockchain may further accelerate this process. The governance mechanism, collaboration mechanism, and incentive mechanism are implemented through a trusted environment, thereby transforming and reshaping relations of production and promoting the restructuring of many organizational relationships [15].

To sum up the above aspects, we can see that blockchain plays a key role in the process of digital economy or Digital transformation. Digital transformation is the use of data, so blockchain is an important infrastructure for data interaction and Digital transformation. Blockchain provides a highway for the flow of data and a trustworthy environment for various collaborations, reshaping many collaboration mechanisms.

4. Planning Strategy and Construction Path of Digital Transformation of University Asset Management

4.1. Phase 1: Internal Integration of Core Business Systems

In the initial stage of information construction, universities have established financial business, equipment maintenance systems, and contract systems. In the later stage, these systems can be used as the core to build an asset integration application platform. By establishing a unified coding system and using information technology to standardize the management process of core business, the integration of physical and value flows of asset core business has been preliminarily achieved.

Realize data exchange between various systems through the service bus of the basic platform. The procurement agreement information of the contract system is synchronized to the logistics system as the basis for subsequent purchase orders and material warehousing; Synchronize the material requisition informa-

tion of the equipment maintenance system with the logistics system to achieve the correlation between maintenance material consumption and the work order; Synchronize inbound and outbound information to the financial system for moving average cost accounting; Synchronize the inbound and outbound information of the logistics system with the contract system to support contract payment applications; Synchronize payment application information to the financial system for matching orders, receipts, and invoices; The fixed asset outbound information is synchronized to the financial system to generate an asset ledger.

4.2. Phase 2: Building an Integrated Asset Lifecycle Management System

To further meet the management requirements for the entire life cycle of assets, a physical asset management platform has been established, and the operational asset management model has been upgraded from the unified management model of the finance department to a three-level management system. The business department and the responsible department conduct normalized transaction processing in the front-end equipment maintenance system, while the finance department receives front-end normalized data updates in the back-end financial system. This model can reverse the passive situation of asset management in the finance department, alleviate its complex asset management work, and empower business department personnel.

Through system integration, fixed assets and materials can be seamlessly integrated into the physical asset management platform of the equipment maintenance system from the logistics system, forming a full process closed-loop management of assets from demand, procurement, acceptance, warehousing, outbound, asset transfer, allocation, maintenance, and scrapping, thus constructing an integrated asset lifecycle management system. The integration of Equipment Maintenance System is shown in **Figure 2**.

4.3. Phase 3: Realize the Integration of Asset Construction and Operational Business

The focus of this stage of work is to build a final accounting system for the completion of projects. By obtaining the construction contract list and settlement list from the contract system, asset checking is carried out from a maintenance perspective to form a physical asset list. Among them, equipment assets are pushed to the equipment maintenance system, and current assets are transferred to the logistics management system. On the basis of the above work, further complete the cost allocation and form a final settlement report for submission. After completing the final audit of the completed project and making adjustments based on the results, the fixed assets will be transferred to the fixed asset module of the financial system and the physical asset management platform of the maintenance system to ensure the consistency of the physical and value of the construction assets and the operational assets after transfer. Through the

completion settlement system, the contract system and financial system in the construction phase are connected with the logistics system and equipment maintenance system in the operation phase, achieving a comprehensive integration of assets across sectors. The integration of Completion Settlement System is shown in Figure 3.

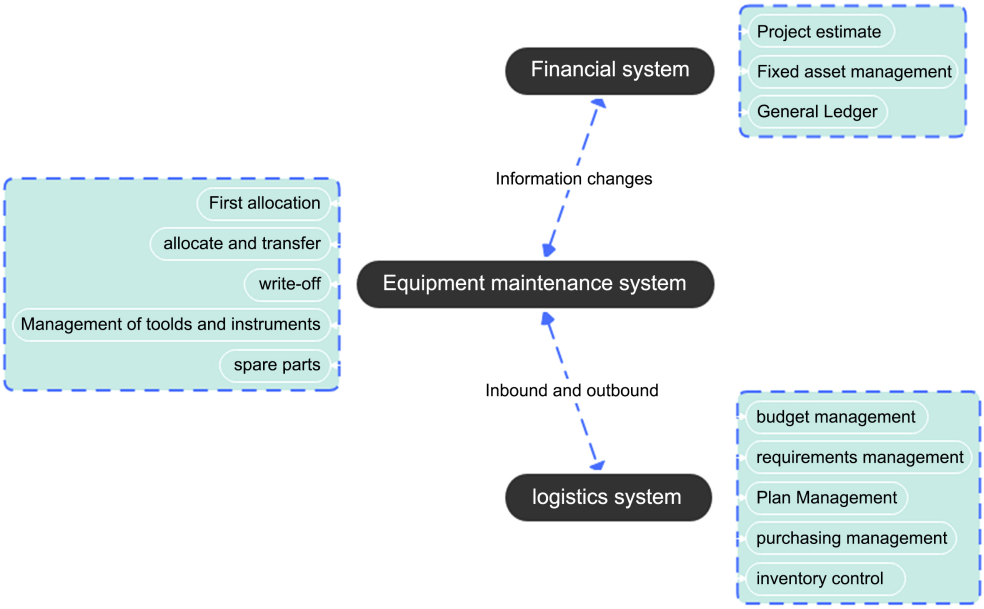

Figure 2. Integration of equipment maintenance system with other systems.

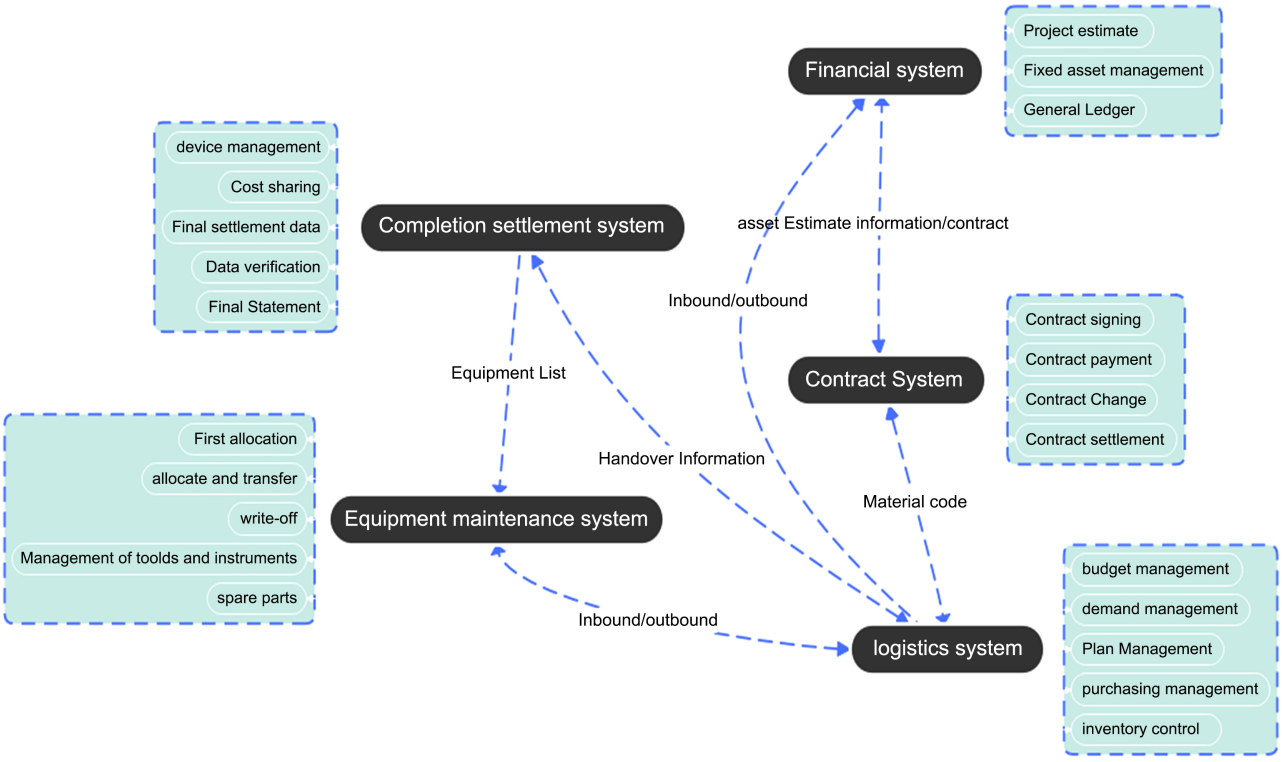

Figure 3. Integration of completion settlement system with other systems.

4.4. Phase 4: Complete Asset Lifecycle Management through the Asset Inventory System

Establish an asset inventory system. By integrating the physical asset management platform of the equipment maintenance system and the asset module of the financial system, information on fixed assets and managed materials can be obtained. Obtain inventory material information through the integrated logistics system inventory management module.

The business of asset changes, transfers, scrapping, etc. is carried out in the asset inventory system and synchronized with the financial system. At the same time, develop a transfer function in the asset inventory system, approve business processes in the inventory system, and push them into the financial system for account processing. After processing, push them to the equipment maintenance system for synchronous updates.

By seamlessly connecting asset inventory systems, financial systems, logistics systems, and equipment maintenance systems, the full lifecycle management of assets has been achieved. The integration of Asset Inventory System is shown in Figure 4.

4.5. Data Governance of Asset Business

4.5.1. Standardization of Management Responsibilities

Organize the development of a series of asset management systems, clarifying the asset management responsibilities and division of labor of each unit, including the "Asset and Material Coding Management Measures", "Fixed Asset Management Measures", and "Asset Labeling Specification". According to the principles and management systems of the entire life cycle of asset management,

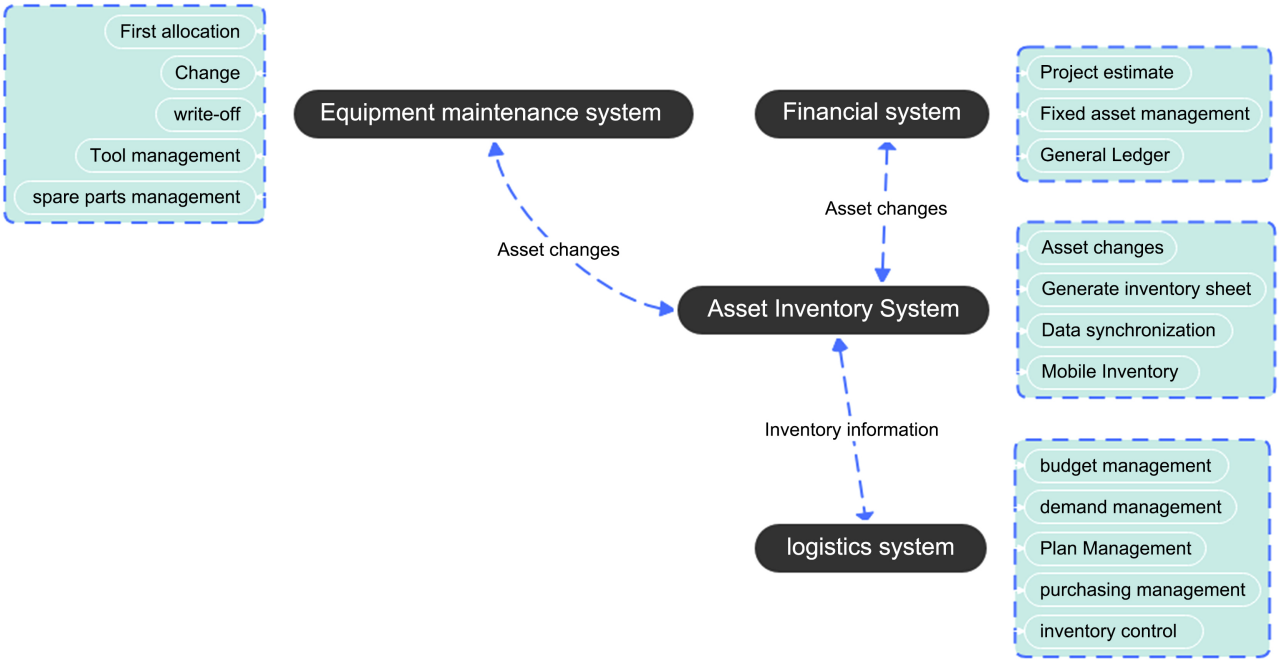

Figure 4. Integration of asset inventory system with other systems.

taking into account the construction and completion of the final settlement system, prepare and transfer the asset list; Taking into account backward operations, the financial system receives assets to form value, and the equipment maintenance system performs asset reception, maintenance, and individual management.

4.5.2. Standardization of Asset Classification

Classify assets based on their value and usage, such as fixed assets, managed goods, consumables, etc. and classified by functional departments, such as information technology, teaching equipment, scientific research equipment, tools, spare parts, etc.

4.5.3. Standardization of Asset Coding System

Construct a data coding system and data standards, integrating asset, equipment, and material codes, and adopting a coding system for the three core systems of finance, equipment maintenance, and logistics. Composed of system (2 digits), subsystem (3 digits), equipment category (3 digits), specification model (4 digits), and serial number (5 digits), represented by a 17 digit font code.

4.5.4. Standardization of Location Coding System

In order to accurately locate the facilities and equipment of various professions and facilitate timely maintenance work, the location coding has been standardized. The location code consists of a park (2 digits), a location category (3 digits), a location subcategory (3 digits), and a specific location (3 digits), represented by an 11 digit font code.

4.5.5. Standardization of Physical Label System

To facilitate on-site positioning of physical objects, labels should be affixed to the objects and the content, size, and material of the labels should be standardized. A label example is shown in Figure 5.

4.5.6. Standardization of Business Processes and Document Styles

Unify the asset management process, including initial allocation, change, transfer (including cross company transfer), scrapping, inventory loss, inventory, etc., and standardize the names and data flow of each process node. At the same time, unify the content and style of various asset documents, including asset transfer orders, asset disposal orders, inventory reports, etc.

Figure 5. Label example.

5. Application Architecture and Innovation Practice of Asset Digital Transformation

5.1. Application Architecture

Divide assets into construction transfer assets and self purchased assets for operation. The transferred assets for construction are entered into various systems through the completion settlement system, while the self purchased assets for operation are entered into various systems through the logistics system. The contract system, completion settlement system, financial system, logistics system, equipment maintenance system, asset inventory system, and other six systems are strongly coupled at different stages to complete the specific tasks of each stage.

The data flow direction between application architecture and systems is shown in the Figure 6.

5.1.1. Asset Management during the Construction Phase

The construction phase is divided into two stages: the transfer of three rights and the final settlement of completion, with assets divided into equipment assets and current assets. Equipment assets need to go through two stages and two transfers before they can form physical and value; Current assets are not limited by time and can be transferred when conditions are met.

1) Handover of equipment assets

During the three rights transfer stage, the equipment asset list enters the equipment maintenance system and does not enter the financial system.

According to the opening of the contract system, based on the physical inventory, each profession prepares an equipment asset list in the final settlement system according to the asset classification rules. After approval, it enters the equipment maintenance system and becomes repairable equipment. At this time, due to the incomplete completion settlement, the final equipment price has

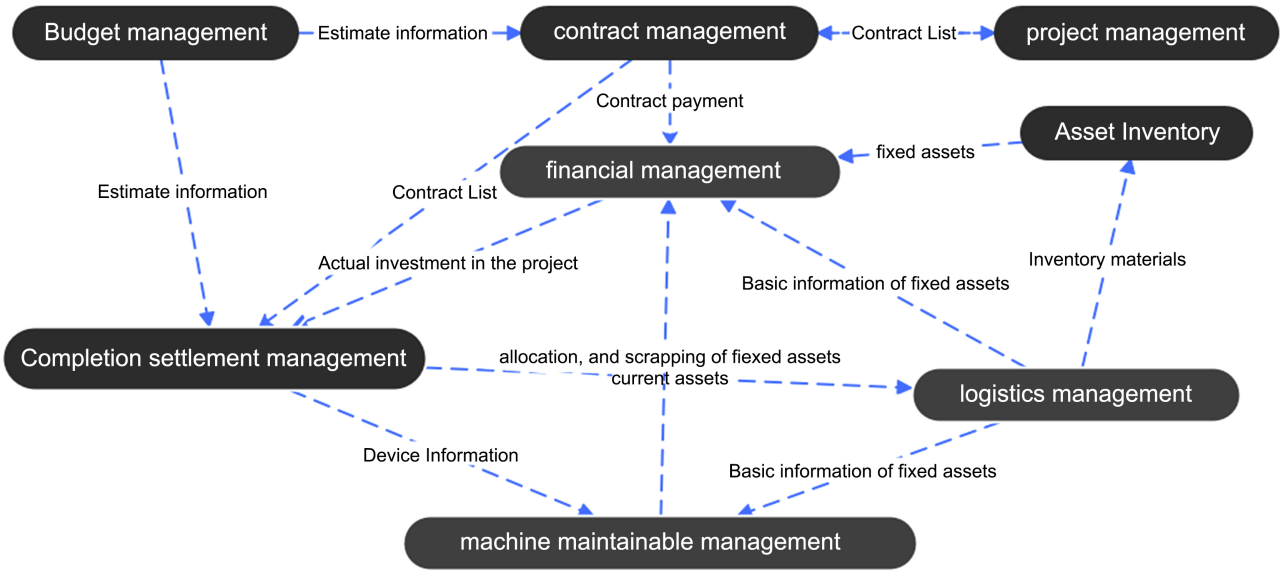

Figure 6. Integrated platform architecture.

not been formed, and the data cannot be transmitted to the financial system temporarily.

After the contract is settled, updates will be made to the adjusted parts of the equipment list, and the updated data will be synchronized to the equipment maintenance system. After the completion of the final settlement, the final equipment price is formed based on the original value and the allocation of internal and external costs in the contract. At this point, the fixed assets are partially entered into the financial system, forming a fixed asset ledger.

2) Transfer of current assets

Current assets can be handed over for approval once they meet the conditions. The user department will split, combine, and code them uniformly in the final settlement system based on the construction contract entry and exit documents according to the requirements of operational material management and the handover progress. After approval, they will be transferred to the logistics system. The subsequent asset management after warehousing shall be carried out according to the asset management requirements of the operation phase.

5.1.2. Asset Management during the Operational Phase

The asset is purchased by the user department, and the logistics system performs operations such as application, procurement, warehousing, and outbound. Asset outbound is distinguished by fixed assets, managed materials, and consumables. After fixed assets and managed materials are outbound, they enter the physical management platform of the equipment maintenance system for individual management. Consumable materials are consumed upon outbound.

There are asset managers of different levels. They are located at the university level, college level, and department level, respectively. They handle various changes in fixed assets and managed materials within the organization in the equipment maintenance system, and achieve linkage with the financial system. The asset data flow is shown in Figure 7.

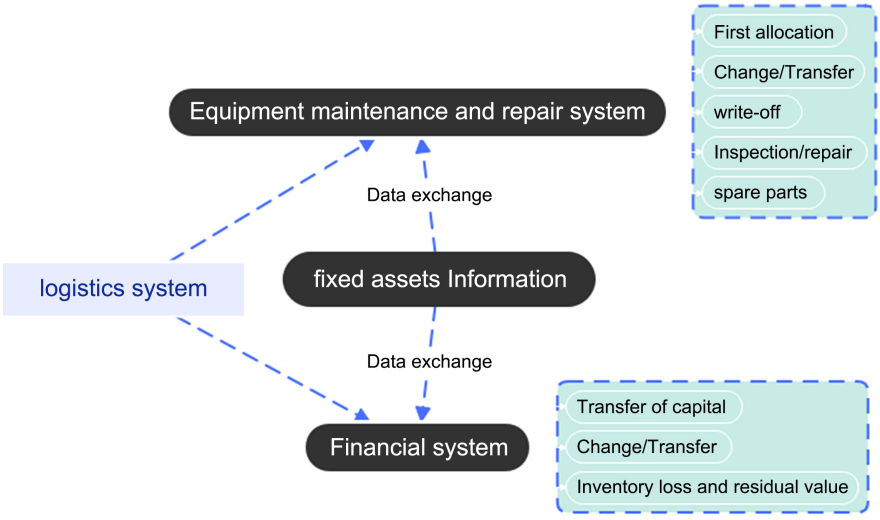

Figure 7. Asset data flow during the operation phase.

5.2. Innovative Practice

5.2.1. Integration of Asset, Equipment, and Material Codes

Unify the coding rules for equipment, materials, and assets, and do not establish multiple coding systems.

5.2.2. Visualization of Asset Coding Using a Low Code Platform

Visualize the whole process management of asset coding, and realize the standardization, standardization and digitalization of asset coding master data management. The addition and change of coding information are all based on low code platforms for form and process operation, fulfilling management responsibilities according to business scope, significantly improving data flow efficiency, effectively improving the sharing and utilization of coding information, and laying the foundation for subsequent system operation and maintenance cost reduction and efficiency increase

5.2.3. Fully Automated and Mobile Asset Inventory

The asset inventory system directly extracts asset and inventory data from the financial system, logistics system, and equipment maintenance system, and flexibly and automatically generates various inventory tables based on various dimensions such as asset department, inventory cycle, and warehouse. If an error is found in the inventory table data, it is necessary to check the data in the financial system, logistics system, or equipment maintenance system, correct the data, and then issue it again. The inventory table can decompose all assets into departments (colleges), departments, teaching and research departments, and other levels according to the three-level asset management system. Multiple levels of asset managers work together to complete the inventory work of the entire university.

In the trend of mobility, the asset inventory system relies on nails to achieve mobility in inventory, and on-site mobile phones scan physical asset labels for inventory. In order to implement the inventory monitoring work, the inventory personnel and the inventory monitoring personnel need to regularly scan and interact with each other, and upload real-time mobile phone positioning to standardize the on-site inventory process.

6. Summary and Prospect

Through the construction of information systems, online applications and approvals for various asset management businesses are supported, replacing the original paper-based transmission and offline processing, improving the timeliness and security of information transmission. Through the integration of business systems, standardize the data that was previously managed separately and repeatedly recorded, ensuring that public data can be entered in one go and shared across the entire school. Through integration, automatic accounting collection is achieved, reducing the manual workload of a large number of financial personnel, comprehensively improving the efficiency of data collection, approv-

al, and accounting processing, thereby saving work costs and improving work efficiency.

Build an asset life cycle management system by building a Digital transformation asset integration information platform. Through the completion settlement system, the fragmented construction phase and operation phase will be connected. By managing and operating assets through various stages, sectors, and focuses, an asset data map is formed to maximize the value of assets, providing the most direct and favorable data strategy basis for management to utilize and manage assets.

Through the above efforts, the goal of Digital transformation of assets can be achieved. Next, data governance, data analysis and application will be carried out in combination with the "data fusion" strategy. Data governance will clarify the information flow chain and management level authority settings of each business system, establish an information authorization sharing mechanism, and constantly improve the efficiency of information management and data quality of each business system; Data analysis and application will make use of new technologies such as workflow platform, low code platform, content management platform and data midrange to comprehensively enable technology midrange, improve the integration capability of business systems in all sectors and the efficiency of information resource utilization, and help Digital transformation to reach a higher level.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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