

RESEARCH ON BUILDING THE SUPPLY WAREHOUSING SYSTEM FOR MID-RANGE AND SMALL ENTERPRISES

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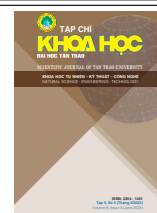
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Abstract:

For business development in the industrial age and in line with the trend of digital transformation, the introduction of ERP (Enterprise Resource Planning), CRM (Customer Relationship Management), and HRM (Human Resources Management) systems has made partly solve the problem of applying information technology to change business models and support business development. But currently, building WMS (Warehouse Management System) on digital platforms is not suitable for some businesses. This research focuses on analyzing and designing a suitable system for enterprises trading in building materials when they need to manage raw material warehouses and production into products.



NGHIÊN CỨU XÂY DỰNG HỆ THỐNG QUẢN LÝ KHO VẬT TƯ CHO DOANH NGHIỆP VỪA VÀ NHỎ

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Thông tin bài viết	Tóm tắt
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1. Introduction

Warehouse Management System (WMS) [1] is an application software designed to support enterprise's warehouse management to perform the functions of controlling and tracking the transfer and storage of goods, available resources. Warehouse management system (WMS) was born to help businesses get an overview of the situation and operations of the warehouse in real time (real-time: a very important term in the management of warehouses.); control warehouse staff; Support the daily planning for the administrator. The warehouse management system helps to ensure high consistency among related departments, meet the management needs, optimize the storage, minimize the loss in the import and export process.

Currently on the digital platform, there are a number of popular and highly ranked warehouse management systems such as Kiotviet, Sapo, etc. These systems have warehouse management operations that fully meet the basic requirements of the system such as: Import and export goods and inventory management, user permissions, reports and businesses can completely use in the management stage to optimize the business model. But there are also businesses that need a system that not only manages the inventory of raw materials, but also manages the process of processing those materials into products for sale. That system needs the integration of the warehouse management system with a part of the sales system, and the bridge between the two is the goods production management system.

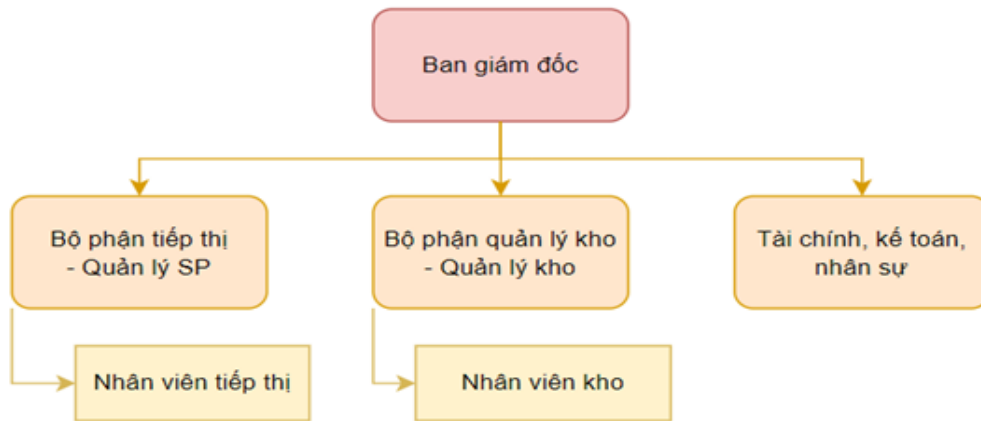


Figure 1: Business Diagram of construction material enterprise

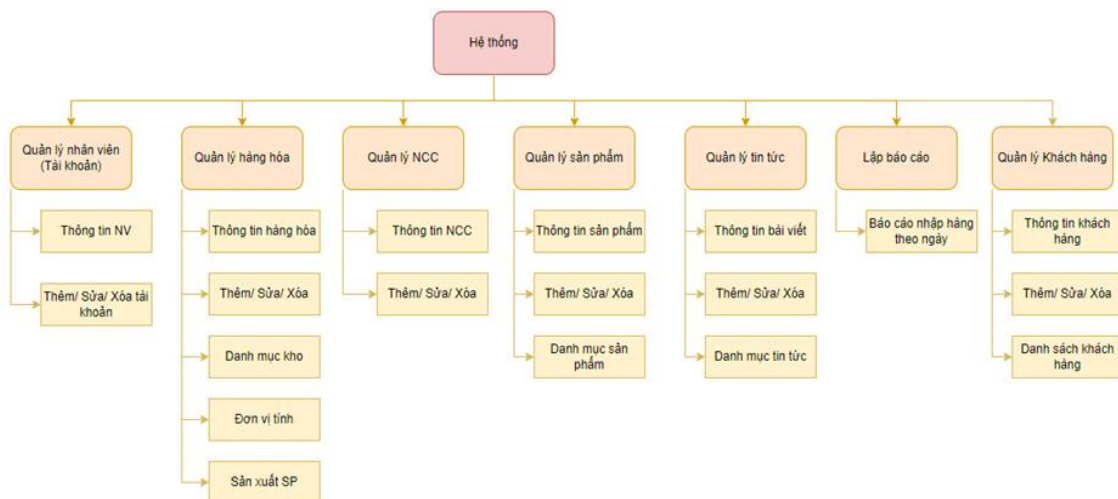


Figure 2: System Functional Diagram

For a company or enterprise producing building materials and construction materials, this is a necessary system. Because their current business model is to import raw materials to the raw material warehouse, then those materials are brought into the factory into products, and finally imported into the product warehouse and sold on the system. the company's sales system.

2. Methods

2.1. Business analysis

After studying the operations of some construction companies, there are usually at least 3 main divisions as described in Figure 1.

- Marketing department: Manage the company's products, participate in the sales process and market to customers about the company's product line. This department is in charge of product management and

customer information stored on the system, in addition, can make production requirements when there is a shortage of products.

- Warehouse management department: Management of importing materials into the company's warehouse, allocating goods to the company's warehouse system. In addition, this department will receive the production request of the marketing department.

- Finance, accounting, human resources departments: Manage monthly material statistics reports, revenue statistics, manage goods status to report to the board of directors. In addition, this department is also in charge of providing accounts for employees participating in the system for the remaining departments and managing and decentralizing those accounts.

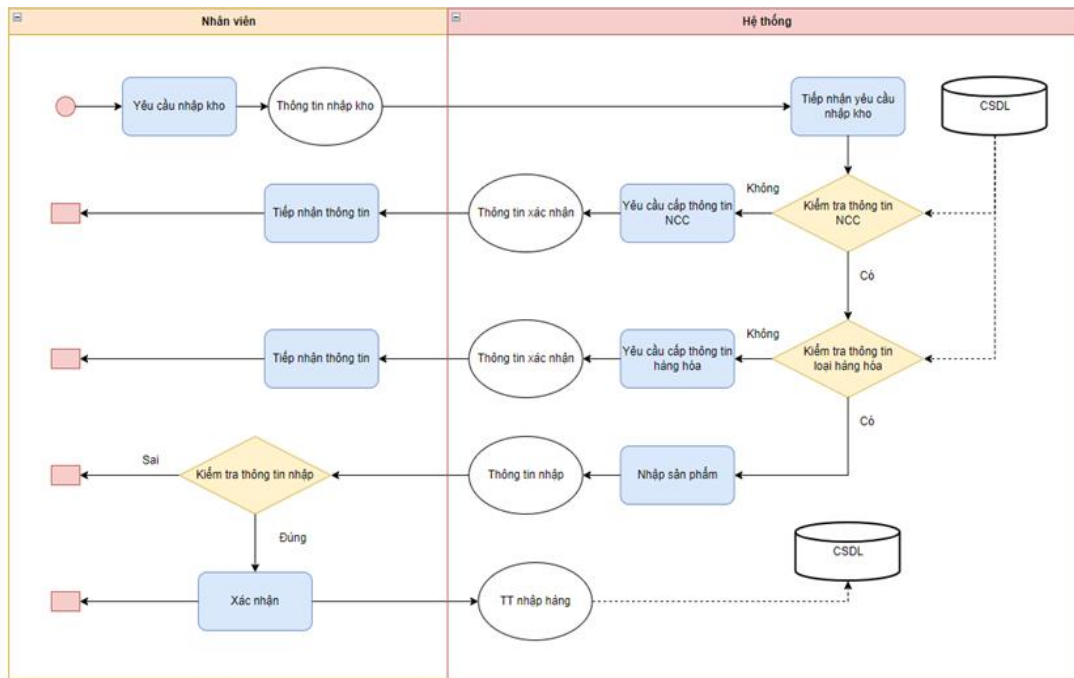


Figure 3: The process of importing goods has the intervention of the management system

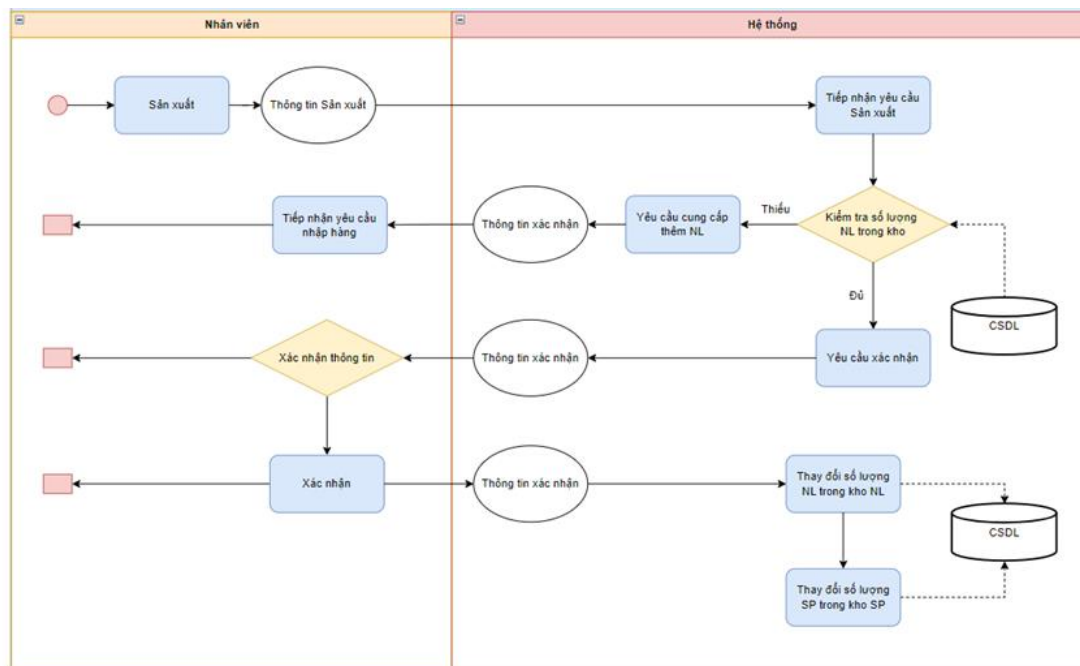


Figure 4: Production process with system intervention

2.2. Functional analysis

Figure 2 is a functional analysis diagram that needs to be researched and developed on the system for enterprises. System built with 7 main functional modules including:

- Account management: Responsible for allocating accounts, editing information, and assigning permissions to accounts in the system. The system needs 1 high-level administrator account , multiple

management-level accounts, and a system of employee accounts divided by functions in the system.

- Management of goods (raw materials): Solve the problem of importing materials into the system, storing and distributing materials to warehouses, storing information about quantity and current warehouse status. In addition, the module has an integrated function of converting raw materials into products (production of products).

- Supplier management: Store information about raw material suppliers, store invoices for importing raw materials into the warehouse.

- Product management: Implement the functions of storing, adding, editing, deleting product information, in addition, the module also has a notification function when products in stock are out of stock, making it easy for users to know product inventory status.

- Customer management: The basic information of customers when contacting the system will be stored, related sales invoices will also be listed.

- News management: Implement the function of posting, browsing articles to post on the website.

- Make reports: Make quarterly or daily reports on product status, chart statistics to control import and sales information.

2.3. Business process

The business processes in the research are explored based on the actual business model of LICOWALL Lightweight Concrete Co., Ltd. LICO WALL Vietnam Light Concrete Co., Ltd. is a unit specializing in manufacturing and supplying EPS lightweight concrete slabs and slabs with many years of experience in the North. But now the company’s business process is operating with many shortcomings in terms of loss of papers, invoices, and the final report is uncertain and there are many errors. Because the business system is working as follows:

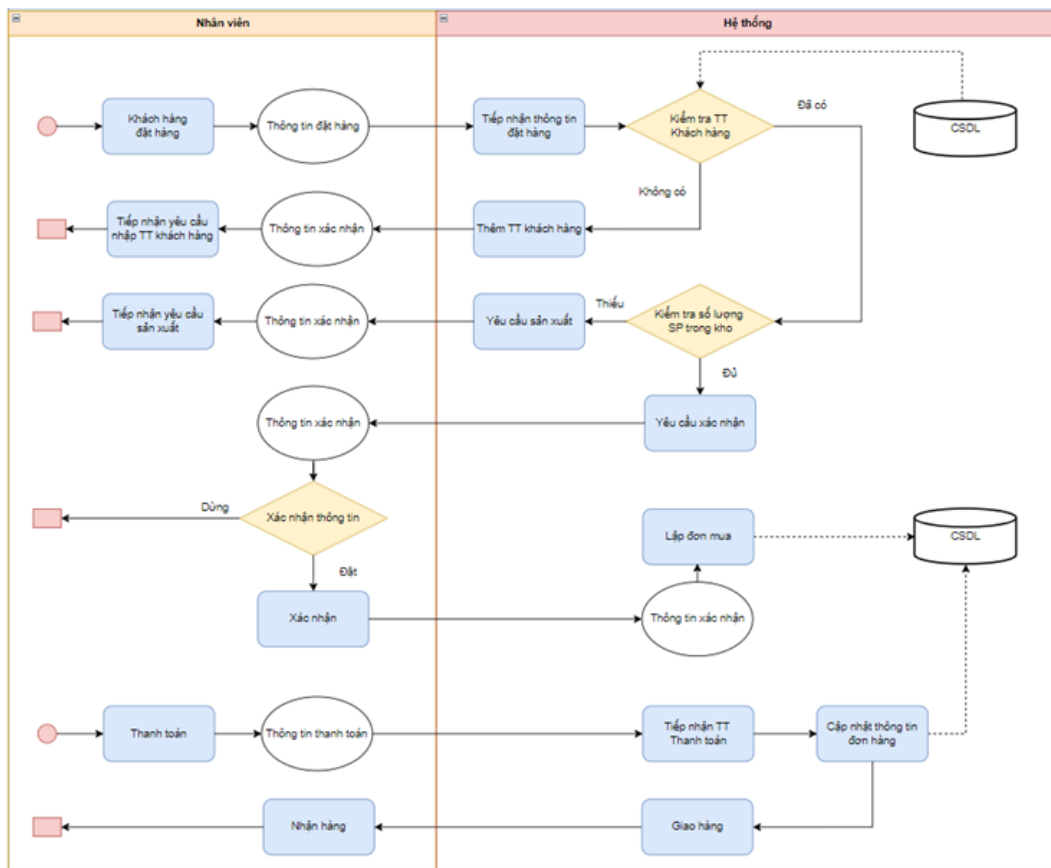


Figure 5: Sales process with system intervention

- Import process: Q is a brief process, starting from the staff contacting the supplier and making an import request. After the supplier ships the goods to the enterprise’s warehouse, the staff will issue a paper invoice and store the order information on paper invoices and Excel files or on books.

- Production process: Currently, the production of goods by the company is to save production information

on the books. Each time of production, the production information will be stored in 1 or more different archive pages on the book, and the production date information will be recorded. This storage has the advantage of being fast, but brings many disadvantages such as reporting and statistics will be lost data, and the loss will make businesses lose a lot of money.

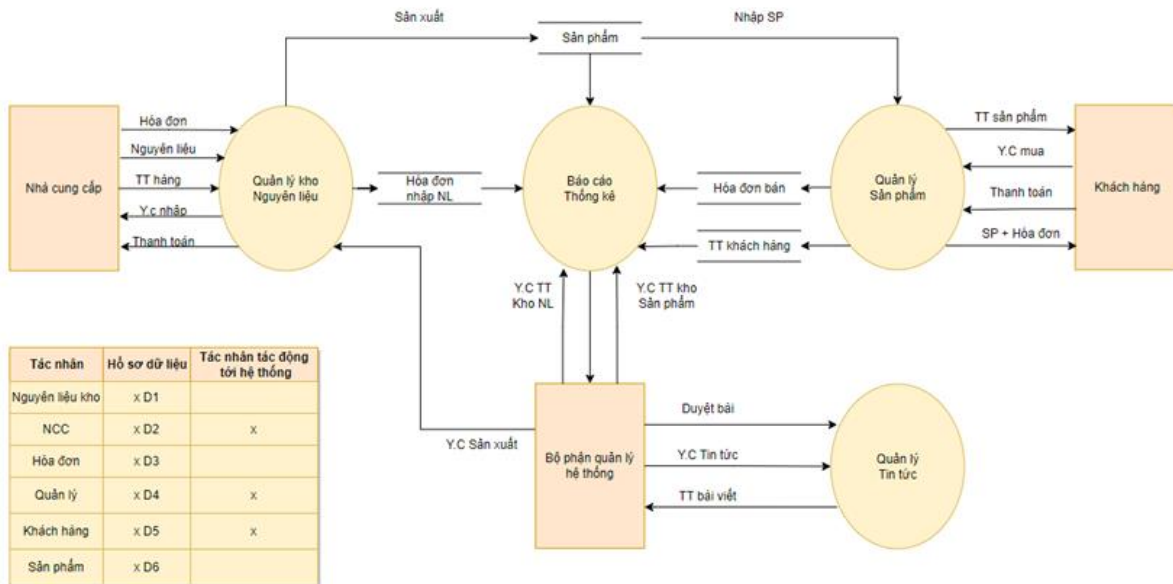


Figure 6: Biểu đồ luồng dữ liệu hệ thống

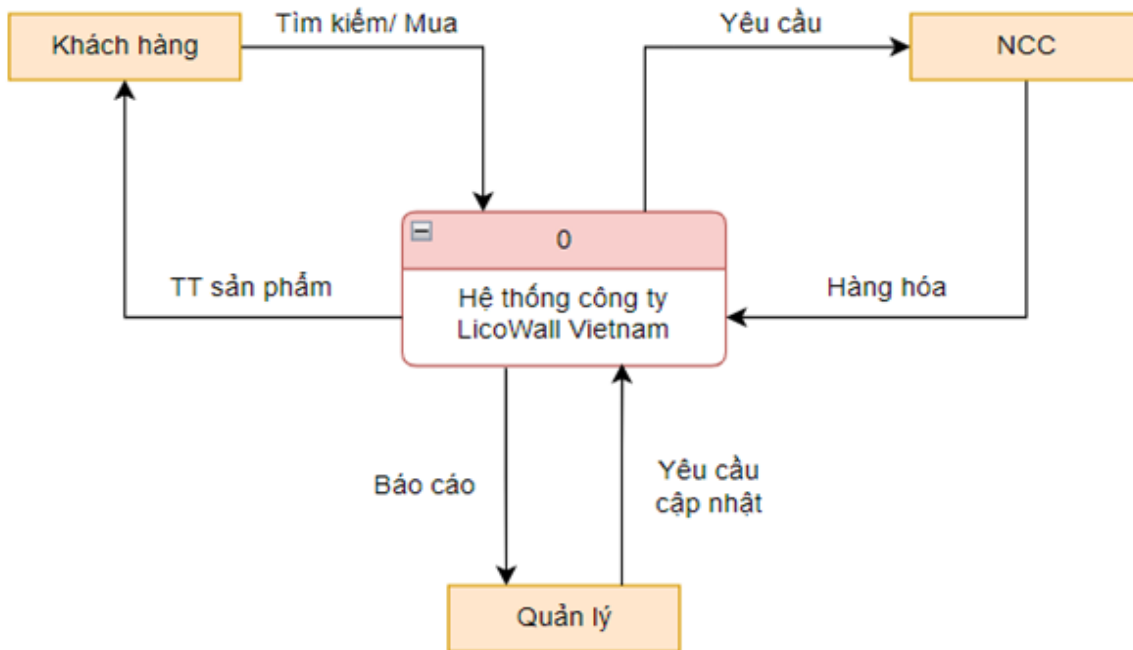


Figure 7: Context Diagram

- Sales process: starting with the customer contacting the company to order, and the staff in charge will store customer information in the customer information book, then store the customer's order. customers to archive files. After delivery to the customer, the staff will issue an invoice to the customer. The sales process is quick but brings a high risk of information when it is possible to lose customer information, lose customers' invoices. Currently, the loss of documents, customer invoice information, invoices and documents makes it more difficult to control the actual situation

of LICOWALL enterprises. The company has also tried using a number of WMS systems to address that situation. But those systems are suitable for the purpose and main function is the management of materials and warehouses, not yet integrated with sales functions or production management functions as required. This is one of many cases faced by construction material enterprises. Existing WMS systems have not yet integrated functions suitable for specific business systems.

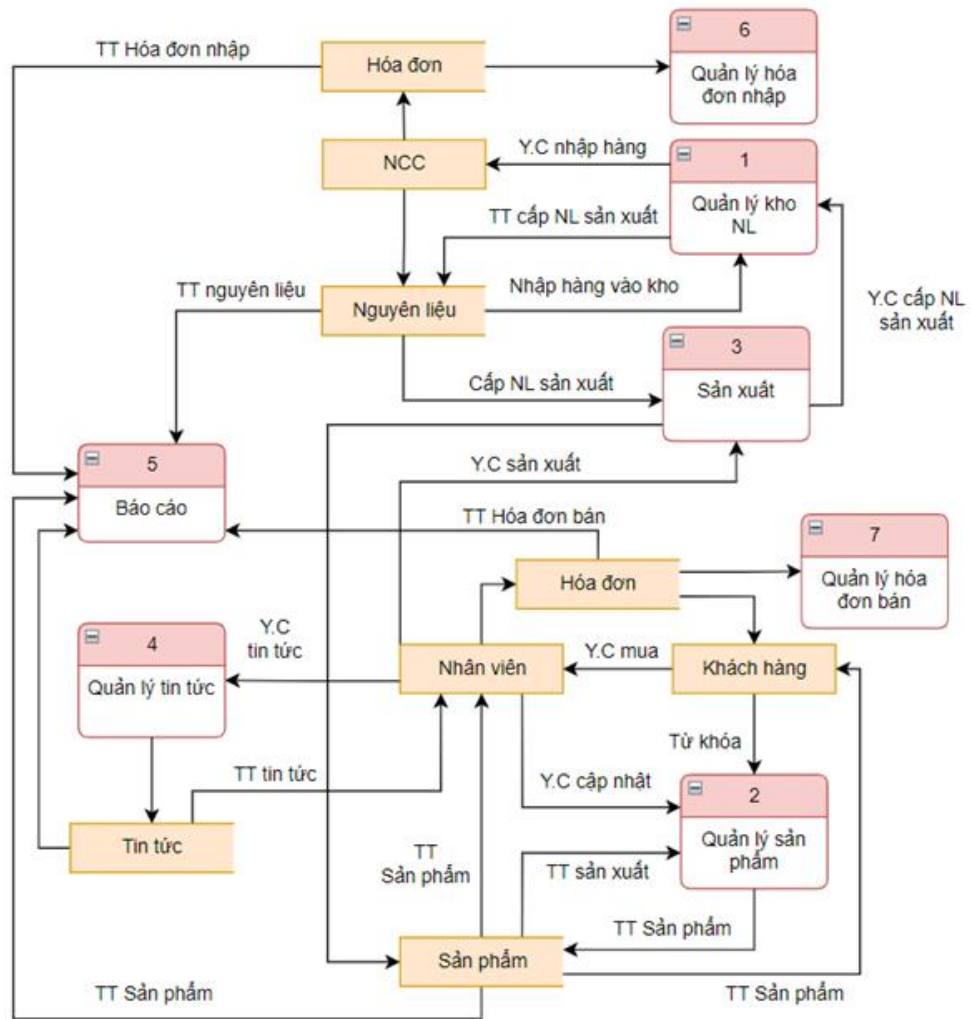


Figure 8: 0-Level DFD

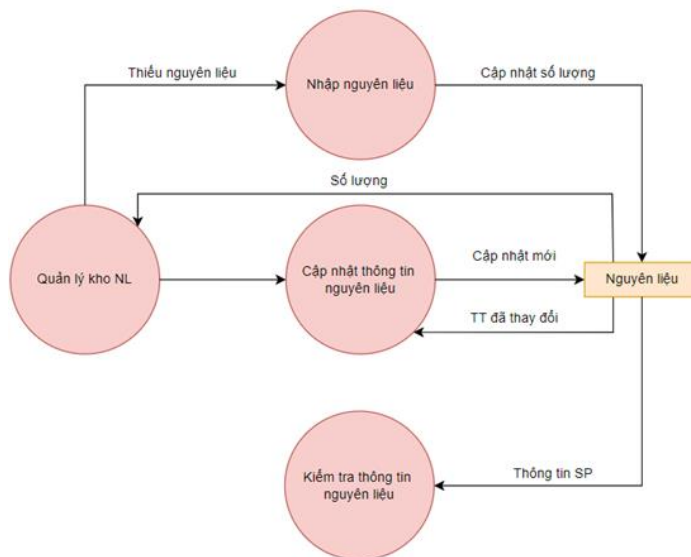


Figure 9: 1-Level DFD - Material Management

3. Results and discussion

After researching and learning about the business activities of building material companies, typically LICOWALL Lightweight Concrete, the development and application of information technology in the process

is essential. set. The management system is researched based on 2 products of Daniel Nuwandinda [3] and Noor Dhia Kadhm Al-Shakarchy [4]

3.1. Integrate systems into business processes

3.1.1. Import process

Figure 3 shows the import process of the enterprise when integrating the management system, the system includes 2 components involved in the process, the

staff and the system. The process retains the original business model, but there will be system intervention to store and address the risk that the current process brings. After the staff receives the raw materials into the warehouse, the document information will be stored on the system, the employee will enter the information to enter the goods into the system, including information about raw materials, quantity, supplier.. the necessary information of a single import.

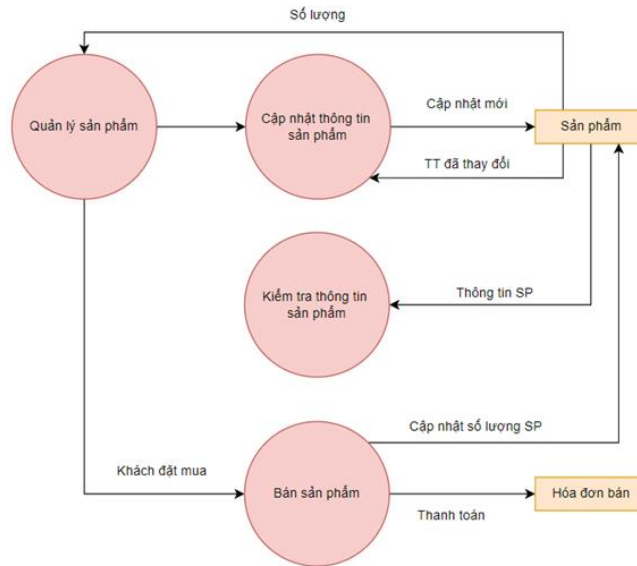


Figure 10: 1-Level DFD - Product Management

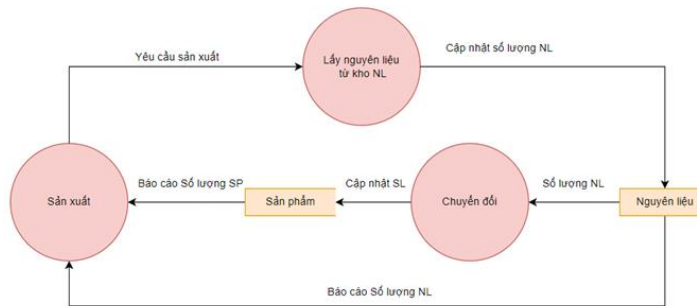


Figure 11: 1-Level DFD - Manufacturing Process Management

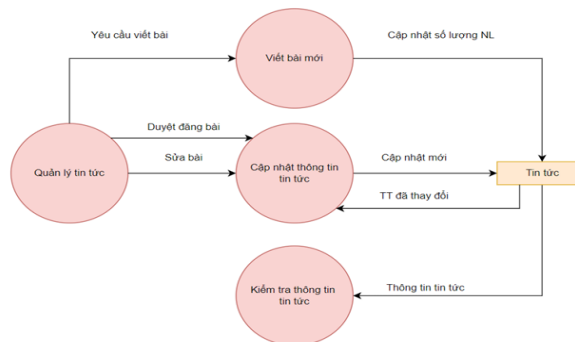


Figure 12: 1-Level DFD - News Management

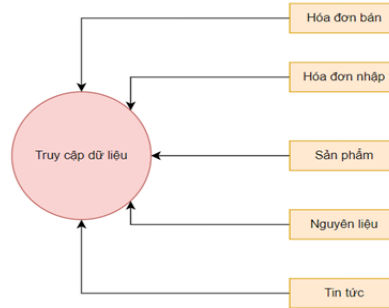


Figure 13: 1-Level DFD - Reports Management

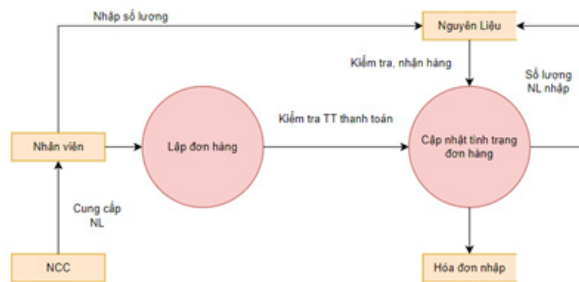


Figure 14: 1-Level DFD - Invoices Management

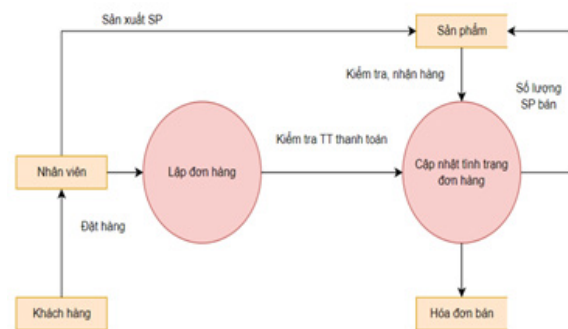


Figure 15: 1-Level DFD - Sale Invoices Management

The warehouse information will be checked and compared by the system in turn, from supplier data to goods information. When information is missing, the system will stop at the missing information stage and return a message to the staff and request to provide enough information to the system. After providing enough information, the staff will check the information for the last time, confirm and finally the system will store the information of that import session. Each completed session will be saved as an invoice entered by the company with the supplier.3.1.2. Production process

The production process (Figure 4) is a process involving the intervention of system software. The system will support employees to store information each time they need to produce products. The system

will receive production information including the amount of raw materials in stock, the number of products produced, the system will be in charge of storing and calculating the remaining raw material data after production. After inputting data, the system will store the production session, and it will help the report settle faster and avoid loss because the system will manage the data in real time, so the data of the product will be processed in real time. Products and materials will be adjusted after the end of the production session.

During a working session, the system will check the input data (quantity of materials) to compare with the quantity of raw materials in stock, if the input data is less than the inventory, the system will return a notification. and request to import more goods. If the input data is more than the inventory, the system

will confirm the production order information, save the production history, change the inventory data of the raw material warehouse, and add more products to the product warehouse. This production process will be requested by the marketing staff when the product stock is not enough and the warehouse management side will do it.

3.1.3. Sales process

The sales process (Figure 5) has the system's intervention to solve the problem of storing customer and order data for statistical reporting. After the customer places an order with the staff, the staff in charge will create the order on the system. The system will check the customer information and respond, if there is information, the customer will continue the

session. Otherwise, the system will notify the request to enter customer information into the system and stop the session. The session will continue to check the number of products in stock after checking customer information. If there is not enough stock in stock, the system gives an alert to the worker requesting production and stops the session at that stage. On the contrary, if in stock meets the requirements for the quantity of products, the system will process the order.

Orders are submitted with the default order status of "unpaid". When the customer pays for the order, the payment information will be entered into the system and the order will be updated as "Paid".

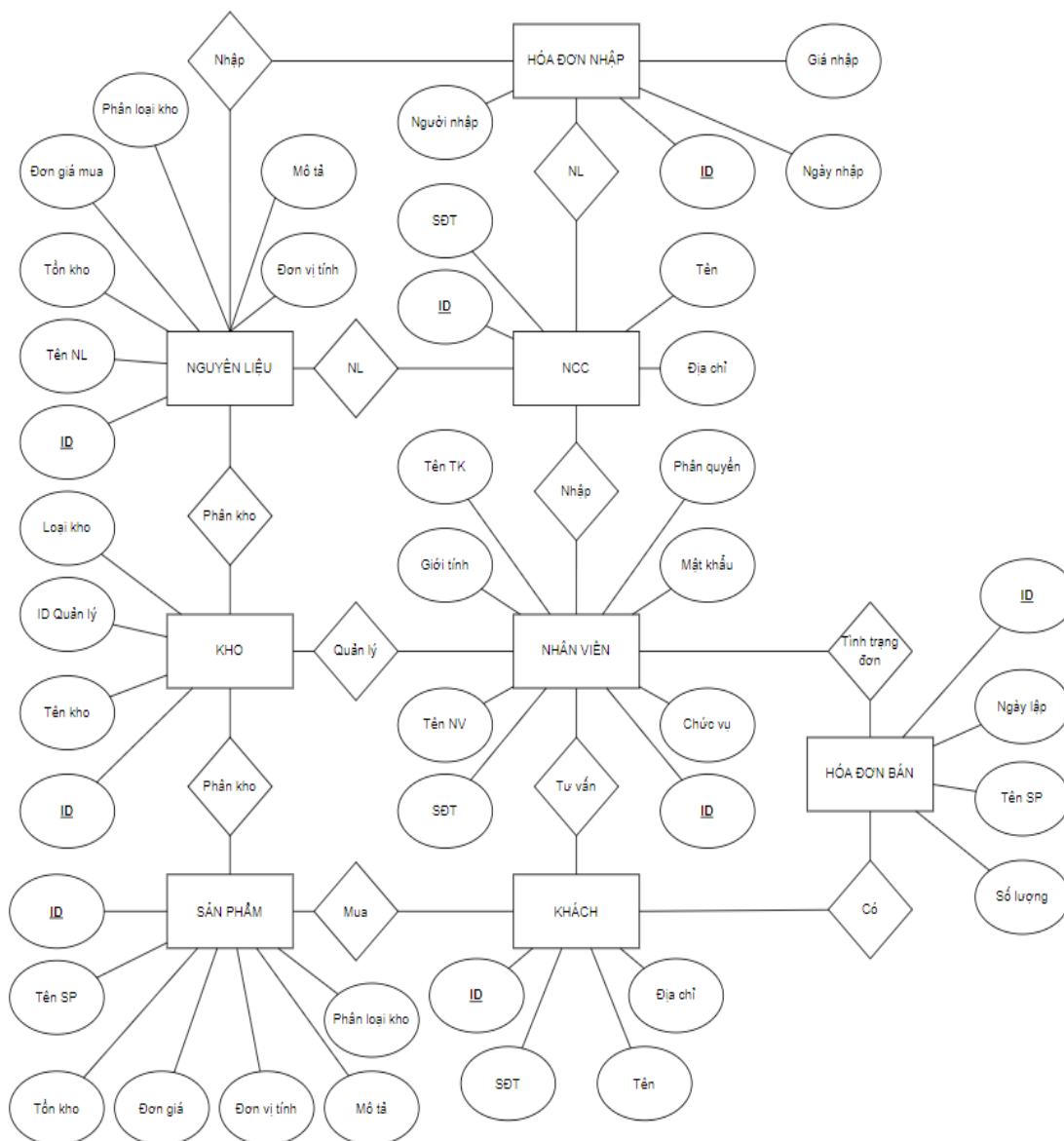


Figure 16: Entity Relationship Model

3.2. Analysis and design of management system

3.2.1. Data flow Diagram

A data flow diagram [2] is a way of representing the flow of data through a process or a system. The DFD also provides information about the outputs and inputs of each entity and the process itself. Data flow diagrams have no control flow - no decision rules and no loops. Building a data flow chart is essential.

The data flow chart is optimized based on the business model of the material business. Figure 6 is a graphical representation with 3 actors affecting the system, respectively, suppliers, customers, and managers (company employees).

3.2.2. Context Diagrams

Context diagram: full is the top level diagram. It gives an overview of the system in the environment it exists in. At this level, the context graph has only a single process, agents, and data flows (no data store). The diagram in Figure 7 gives an overview of the relationship between the interacting agents and the system.

3.2.3. Levels Diagrams

The level 0 graph is a decay diagram from the context graph. For the purpose of describing the system in more detail, the level 0 diagram is decomposed from the context diagram with the processes presented as the main functional items of the system. The system under study includes 7 main modules shown in Figure 7, including:

- Management of raw material warehouse (Figure 9): The warehouse management module has 3 main jobs: inputting data, updating raw material information, and checking raw material information. The corresponding actions will be executed on the system.

- Product management (Figure 10): Product management module consists of 3 main jobs: updating product information, checking product information and selling products. For product sales, the system will send invoice information to the sales invoice module. This module can be extended to the customer side when it is possible to display product information on the information website integrated with the system.

- Production management (Figure 11). The production management module consists of two main jobs: taking raw materials from the warehouse

and converting raw materials into products. After completing the work, the system will report the number and save the session.

- Management of news (Figure 12): With the news management module in Figure 12, the work is similar to the product management module. In addition, in this module, the system will set the status of the article after the employee posts it to "Unpublished", after being approved by the management, the article will be changed to "Posted" and displayed on the website. on the system for customers to view.

- Report (Figure 13): The reporting module will get data stored in the system about product information, invoice information, raw material information, news information for statistics for managers and employees participating in the system to view.

- Management of imported invoices (Figure 14): The module will perform the main tasks of inputting raw material information, invoicing, updating material information after invoicing.

- Management of sales invoices (Figure 15): The main function of the module is to create sales invoices after customers place an order and update order information after customers pay.

3.2.4. Entity Relationship Model

Entity Relationship model (ER) introduced by CHEN in 1976 is a widely used model in conceptual database designs, built on based on perceiving the real world through a set of objects called entities and the relationships between these objects. Compared with the network model, the entity-relationship model has more advantages and it is more representative of the real-world components. If the network model only represents the main objects but does not describe the characteristics in that object, in the entity-relationship model, these weaknesses can be overcome. Therefore, the choice of this model is always a decision of database design analysts because it is an intermediate step in the transfer between real data into system data.

Figure 16 clearly shows the relationship between the actors in the system and the information related to those objects.

3.3. Build a database

Figure 17 explains the design of the system data storage. Data tables show entities and their associated

attributes. It contains primary keys (Primary Key - PK) and accompanying secondary keys (Foreign Key - FK) that show the relationship of data tables to each other. The data columns in the table are all specified for the appropriate stored data type (int, varchar, ...). Many-to-

many (nn) relationships are split into one-to-many (1-n) relationships with intermediate tables. This database is designed to be suitable for database storage systems such as MySQL, SQL Server.

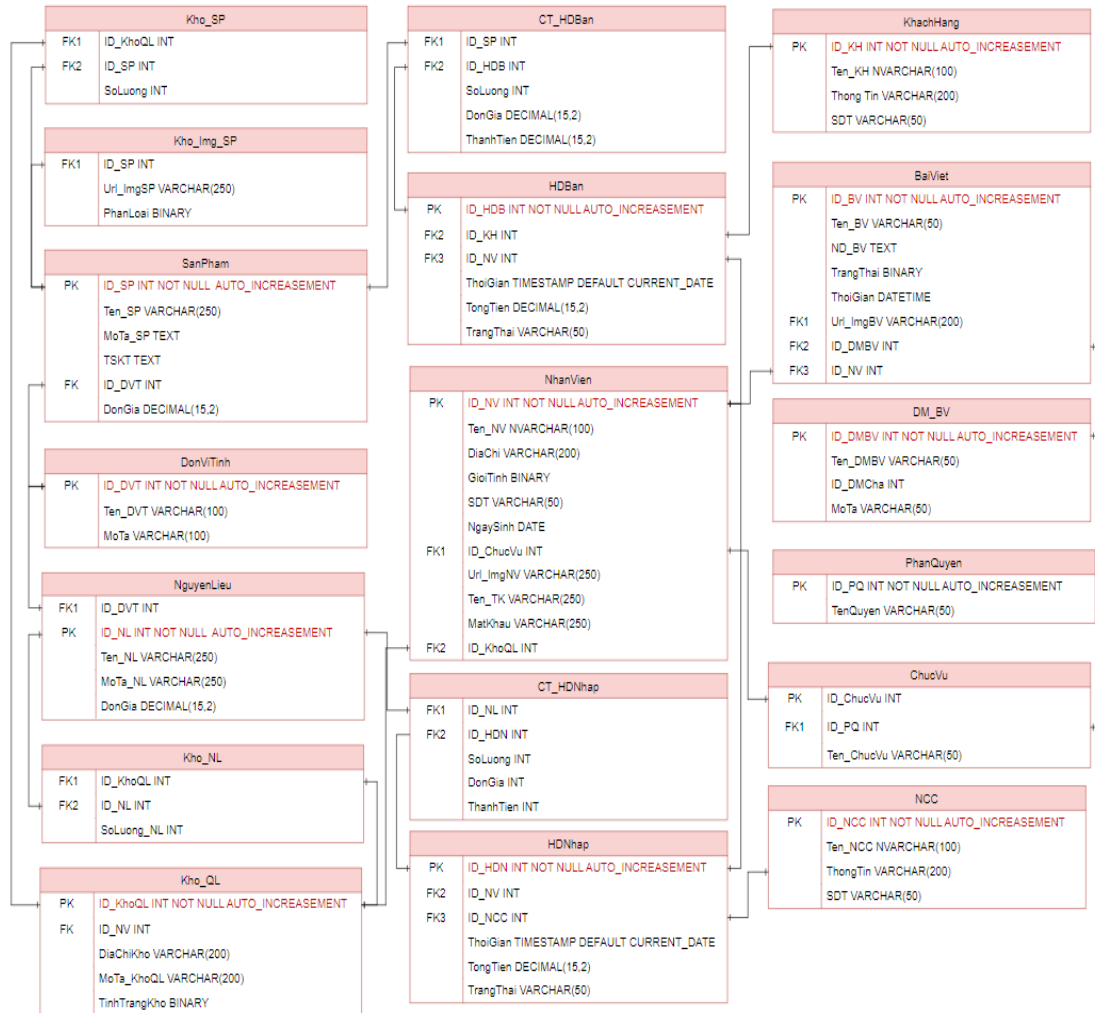


Figure 17: Relational database

3.4. Discussions

The system in this study has provided complete information to stage 3 of the information system development process [8] and stages 4 to 6 of the process being developed.

In phase 4, the system is being built and piloted on the system of LICOWALL lightweight concrete company. The system is built on PHP Core platform with MVC[9] model.

The study presents a system model that is different from the current common warehouse management systems. Currently, warehouse management systems are developed for the purpose of storing goods and

controlling the import and export of warehouses, for that purpose, these systems are suitable for businesses from small to large with business processes. and business models that need to control operations from data entry, invoicing, inventory, and shipping. The study has provided a model that fully integrates the above functions of necessary warehouse management, and builds more necessary functions for specific businesses, businesses that need to integrate production systems. products from goods are imported into the warehouse, and in addition, a customer-side interface such as a CMS system can be developed.

With the above functions and development, the system is suitable for small and medium enterprises in

the field of construction material warehousing that have a process of producing products from raw materials (for example, brick manufacturing enterprises, flooring, furniture, etc.).

4. Conclusion

Today, with the application of science and technology to business processes being an important trend, digital transformation for businesses makes business and management easier than ever.

On the digital platform, there are many systems suitable for the needs and purposes of enterprises such as CRM, HRM, CMS. For a large WMS system like Kiotviet or Sapo, the main function of the system is focused in the direction of managing warehouses and warehouses in large quantities, but the problem of data conversion from raw materials to raw materials has not been solved yet. finished product. For companies that have a raw material warehouse to manage and also have a workshop to process raw materials in stock into products for sale such as LicoWall Vietnam or self-construction businesses, the need for a specialized WMS system is very large.

The study has built a specialized system for small and medium-sized enterprises with needs in the field of warehouse management and production. Although this system is not as powerful as previous WMS systems, it meets the needs of digital transformation for necessary businesses, and the system's ability to upgrade and develop is very large. Here is a solution to bring technology into the business: build a warehouse management system with integrated production.

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