

Design of Warehouse Management System Based on L Company

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Abstract: The rapid development of modern society, for any enterprise, especially manufacturing and logistics enterprises, will be the external power to improve management efficiency. In 2020, COVID-19's impact has caused heavy losses to all enterprises. The improvement of the efficiency of warehouse management in manufacturing enterprises is imminent. Taking L company as an example, this paper develops a C / S warehouse management system based on C # language, in order to realize intelligent warehouse management and efficient warehouse operation, such as material information management, data entry of warehouse in and warehouse out operation, inventory checking, etc., to help enterprises improve efficiency and reduce costs.

1. Introduction

With the development of the economy, the society is developing at a rapid speed. No matter for individuals or enterprises, the development of high efficiency and low cost is required. With the influence of COVID-19 in 2020, most enterprises stop working, which makes the survival pressure of enterprises bigger. For manufacturing and logistics enterprises, the impact of production and development is not only production efficiency, but also warehouse management, because warehouse management balances all aspects of logistics operation and integrates logistics operation [1]. Therefore, in the post epidemic era, the demand for intelligent warehouse management is imminent. In June 2020, China's development and Reform Commission and the Ministry of transport put forward in the "notice on the implementation of opinions on further reducing logistics costs" that it is necessary to speed up the digital upgrading of goods management, transportation services and station facilities, and improve the intellectualization of logistics links such as warehousing and distribution. In the information age, the management information system is widely used, which is through personnel control and database collection, analysis, to achieve the direct or indirect control of product data between the various positions of the enterprise, strengthen information communication, and achieve enterprise goals [2]. It is self-evident that the warehouse management system, which is the basis of intelligent warehouse system, is necessary for enterprises.

Through the use of WMS, the company can control the import and export of goods [3]. And it can effectively help enterprises get rid of the "slow, chaotic and poor effect" of traditional warehouse. On the one hand, it can realize the storage of warehouse information through database. On the other hand, it can speed up the sharing of information, help enterprises realize fine management [4] and improve the efficiency of warehouse operation, Improve the income of enterprises. L company mainly promotes the development of the third-party logistics with the traditional commerce and trade, and promotes the expansion of the traditional commerce and trade business with the support of the third-party logistics, that is, the mode of "Commerce and Trade Logistics + Third-party Logistics". In the follow-up development, the innovative mode of "Platform + Base" is proposed. This paper will take L company as an example to design and develop the warehouse management system, so as to achieve efficient warehouse management.

2. Demand Analysis and Feasibility Analysis

2.1. Demand Analysis

2.1.1. Functional Requirements

1) Information Processing Requirements

Warehouse management plays a key role in the management of enterprises selling physical goods, which directly affects the management efficiency and production efficiency of enterprises[5]. As an electronic platform, L company's "Platform + Base" mode determines the large number of its suppliers and customers, its inventory demand is very large, and its storage requirements are also very high. If a large amount of data information is not handled well, it will greatly affect its work efficiency. The traditional warehouse management mode stores a large amount of information data in paper form. On the one hand, the information is not easy to save and easy to be lost. On the other hand, the efficiency of searching the required information is low, which will increase the investment of human, material and financial resources. Therefore, the information needs of L company is to realize the accurate input and storage of a large number of data and information, and to search efficiently when necessary, so as to free the management staff from the heavy and miscellaneous information management work. Therefore, the information processing requirements of L company for the warehouse management system is to liberate the company from the traditional inventory information management mode, so that the company can grasp and judge the inventory information more reasonably and accurately, and also provide an accurate, clear and relaxed warehouse information management environment for the staff.

2) Specific Operation Requirements

Warehousing is not a simple sense of storage, but in-storage, inventory management, out-storage as a whole[4]. However, the traditional warehouse management not only reduces the work efficiency, but also increases the error rate[6]. This requires the warehouse management system to complete at least the most basic functions of in-storage and out-storage, query and inventory. The specific operation functions should include: material data management, employee data management, business partner data management, warehousing management, outbound management and inventory management, including safety stock warning, warehouse partition, inventory information query,

system maintenance, including user-defined settings, permission settings and user password self modification, etc.

A. Operation of material data, employee data and business partner data: add, modify, query or delete records in the information table.

B. Management of in-storage: , modification, query, deletion and storage allocation.

C. Management of out-storage: information input of out-storage, modify, query, delete and storage allocation of delivery information.

D. Early warning of safety stock: calculate the safety stock for each kind of goods or each supplier's stock according to the demand, and when the stock quantity is lower than the safety stock, the system will automatically pop up the warning of insufficient stock.

E. Warehouse partition: according to different product categories, models and delivery frequency, conduct IQ analysis, and reasonably partition and manage the warehouse.

F. Inventory information query: query the inventory with different business partners or categories.

G. Permission setting: modify and set the user's permission.

User password modification: users can modify and reset their own passwords.

2.1.2. Flow Chart

1) Data flow diagram (DFD)

The high degree of information sharing needs to be realized on the information platform, so in order to achieve the sharing of logistics information and improve the efficiency of logistics activities, we need to establish a unified electronic information platform[7]. In the process of warehouse management using the platform of warehouse management system, in order to facilitate the query and statistics of data, the server-side database will manage, store and apply the whole data[8]. The system in this paper is a platform built by visual studio and SQL Server software Server establishes a database for data storage. After the information is entered through the warehousing system, the system stores the data in the warehousing database. When it is necessary to carry out warehousing or information call, the system will extract data from the database. The data flow chart is shown in Figure 1.

2) Business flow chart

The specific business process of the system is as follows:

A. The administrator registers / enters the employee information;

B. Employees register / input materials and business partner information;

C. Calculate and set material safety stock;

D. Material allocation, including delivery and storage;

E. When out-storage and in-storage lead to the change of stock quantity, inventory information management (including query, etc.) is carried out, and the next material allocation is carried out by comparing with safety stock.

The whole business flow chart is shown in Figure 2.

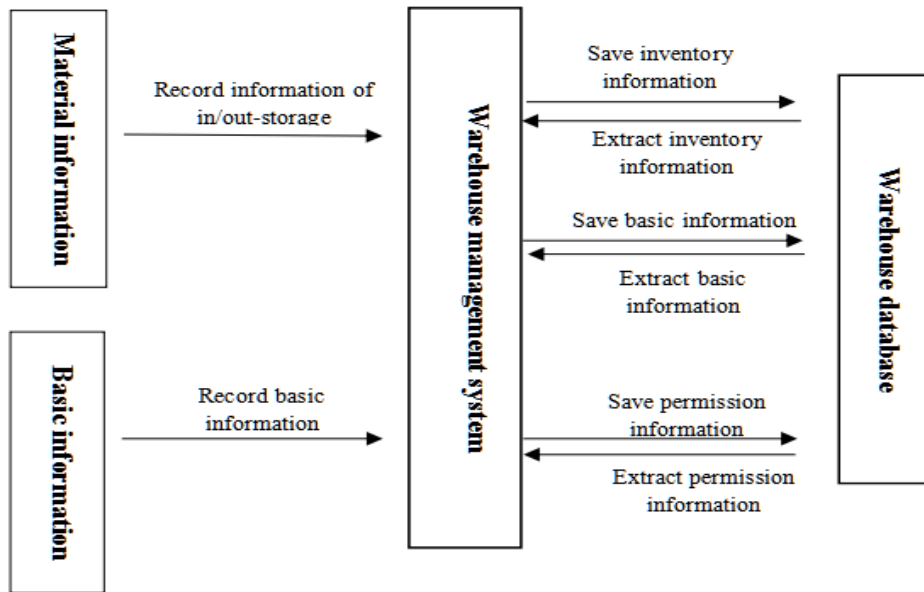


Figure 1: Data flow char of warehouse management system.

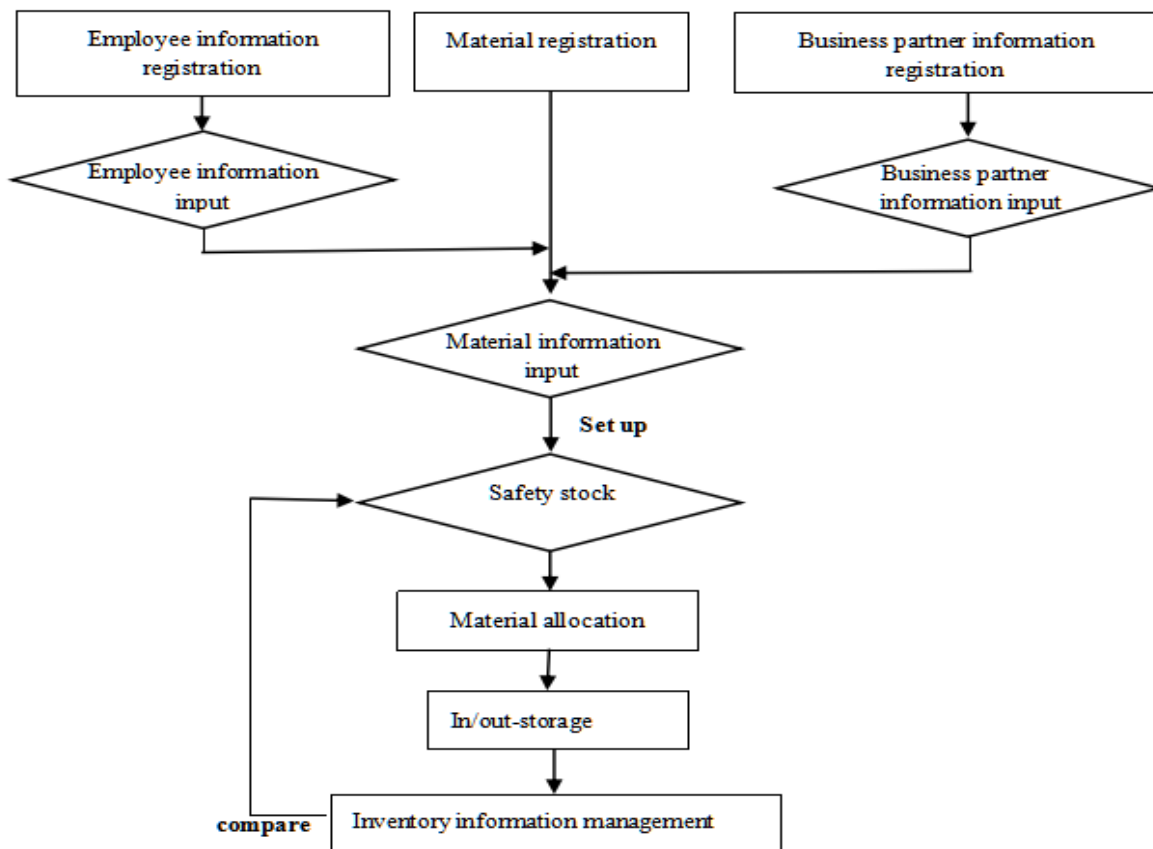


Figure 2: Business flow chart.

2.2. Feasibility Analysis

1) Analysis requirements

Based on the comprehensive automation of warehouse management, it is required to greatly improve the work efficiency of warehouse staff, greatly reduce the disadvantages of cumbersome, disorderly and long cycle of previous incoming and outgoing processes, and reduce the loopholes of in-storage management, out-storage management and inventory management, save management expenses[5], increase enterprise income, realize the automation of warehouse management operation and information, and realize the full automation Improve the warehouse management level.

2) Factors determining feasibility

A. Technical feasibility

This system uses mature and perfect visual studio and SQL Server software development tools to manage, operate and maintain the background database. The software has powerful function and strong usability, which fully meets the practical requirements.

B. Economic feasibility

Due to the uncertainty of customers, the operation mode of L company's platform + base is more difficult to manage. If the warehouse management software is used, the management level will be improved and the enterprise will bring rich economic benefits. And the software development cost is low, takes up less resources, and is economically feasible.

C. Operational feasibility

The system has clear design ideas, simple operation, good user interface, and can be used skillfully by general warehouse management personnel.

3) Feasibility evaluation

This system uses mature and perfect visual studio and SQL Server software development tools to manage, operate and maintain the background database. Powerful function, convenient operation, strong usability, convenient warehouse management, improve the management level. The system has the advantages of short development cycle, low development cost and short cost recovery cycle, which is suitable for L company's "platform + base" operation mode of warehouse management.

3. Conceptual structure design of database

The conceptual structure design stage is the key to the design of the whole warehouse management system. It forms a conceptual model independent of the specific DBMS by synthesizing, inducing and abstracting the requirements.

According to the functional requirements and data flow analysis of the warehouse management system, the database of the system is named *StoreMIS*. The database includes: a. business partner information table (*Partnerinfo*); b. material information table (*Materialinfo*); c. staff information table (*Staff*); d. in-storage information table(*Ininfo*); e. out-storage information table (*Outinfo*); f. warehouse information table (*Storehouse*); g. Role information table (*Roles*); h. Material category information table (*MTpeinfo*). Table 1-8 shows the data structure of each object.

Table 1: Data structure of *Partnerinfo*.

Field name	Type	Describing
<i>PID</i>	Varchar (10)	Business partner number (primary key)
<i>PName</i>	Varchar (50)	Business partner name
<i>PLName</i>	Varchar (50)	Abbreviation of business partner
<i>PType</i>	Varchar (50)	Aategory

Table 2: Data structure of *Materialinfo*.

Field name	Type	Describing
<i>MID</i>	varchar(20)	Material number (primary key)
<i>MName</i>	varchar(50)	Material name
<i>PID</i>	varchar(10)	Business partner number (foreign key)
<i>MTypeID</i>	varchar(10)	Material category number (foreign key)
<i>MAccount</i>	nvarchar(50)	Quantity of materials
<i>Msafe</i>	nvarchar(20)	Safety stock
<i>Mprice</i>	nvarchar(20)	Unit Price

Table 3: Data structure of *Staff*.

Field name	Type	Describing
<i>StaffID</i>	varchar(10)	Employee number (primary key)
<i>StaffName</i>	varchar(50)	Employee name
<i>StaffPlace</i>	varchar(50)	Employee position
<i>StaffTel</i>	varchar(50)	Staff phone
<i>RoleName</i>	varchar(50)	Role name (foreign key)
<i>PWD</i>	varchar(10)	password

Table 4: Data structure of *Ininfo*.

Field name	Type	Describing
<i>InID</i>	varchar(20)	Serial number of in-storage (primary key)
<i>MID</i>	varchar(20)	Material number (foreign key)
<i>InAccount</i>	nvarchar(50)	Quantity
<i>InPrice</i>	nvarchar(50)	Unit Price
<i>InValue</i>	nvarchar(50)	Total amount
<i>InData</i>	datetime	Time of in-storage
<i>InDealer</i>	varchar(50)	Handling personnel
<i>InSaver</i>	varchar(50)	Custodian
<i>SHID</i>	varchar(10)	Warehouse area number (foreign key)
<i>Remark</i>	varchar(50)	Remarks

Table 5: Data structure of *Outinfo*.

Field name	Type	Describing
<i>OutID</i>	varchar(20)	Serial number of out-storage (primary key)
<i>MID</i>	varchar(20)	Material number (foreign key)
<i>OutAccount</i>	nvarchar(50)	Quantity
<i>OutPrice</i>	nvarchar(50)	Unit Price
<i>OutValue</i>	nvarchar(50)	Total amount
<i>OutData</i>	datetime	Time of out-storage
<i>OutDealer</i>	varchar(50)	Handling personnel
<i>OutUserer</i>	varchar(50)	Custodian
<i>SHID</i>	varchar(10)	Warehouse area number(foreign key)
<i>Remark</i>	varchar(50)	Remarks

Table 6: Data structure of *Storehouse*.

Field name	Type	Describing
<i>SHID</i>	varchar(10)	Warehouse area number(primary key)
<i>MTypeID</i>	varchar(10)	Material category number (foreign key)

Table 7: Data structure of *Roles*.

Field name	Type	Describing
<i>RoleName</i>	nvarchar(50)	Role name (primary key)
<i>DatumManage</i>	varchar(10)	Basic data management
<i>InManage</i>	varchar(10)	Warehousing management
<i>OutManage</i>	varchar(10)	Outbound management
<i>SystemManage</i>	varchar(10)	System management
<i>StoreManage</i>	varchar(10)	Inventory management
<i>OtherFunction</i>	varchar(10)	Other functions

Table 8: Data structure of *MTypeinfo*.

Field name	Type	Describing
<i>MTypeID</i>	varchar(10)	Material category number (primary key)
<i>MTypeName</i>	text	Material category

4. System Implementation

4.1. Database Connection

In the warehouse management system, database connection is particularly important. In this system, data connection is carried out in the *DBclass*. The code is as follows:

```

using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using System.Data;
using System.Data.SqlClient;
using System.Windows.Forms;

namespace warehouse management
system1
{
    class DBClass
    {
        /*
        *
        */
    }
}

```



```

        void OpenDB(string
dbcnn); //Open database
        void CloseDB();
        bool ExecuteSQL(string
sql);
        DataSet GetDS(string
sql); /*
        SqlConnection cnn = new
SqlConnection();
        public static string
userName = null;
        public static string
userPass = null;
        public static string Role
= null;
        public void OpenDB()
        {
            cnn.ConnectionString = "data
source=2012-20130804QR;initial
catalog=StoreMIS;uid=sa;pwd=123
4";
            if (cnn.State ==
ConnectionState.Closed)
            {
                cnn.Open();
            }
        }
        public void CloseDB()
        {
            if (cnn.State ==
ConnectionState.Open)
            {
                cnn.Close();
            }
        }
    }

        public bool
ExecuteSQL(string sql)
        {
            OpenDB();
            SqlCommand sqlcmd =
new SqlCommand();
            sqlcmd.Connection = cnn;
            sqlcmd.CommandType =
CommandType.Text;
            sqlcmd.CommandText = sql;
            if
(sqlcmd.ExecuteNonQuery() > 0)
            {
                CloseDB();
                return true;
            }
            else
            {
                CloseDB();
                return false;
            }
        }
        public DataSet
GetDS(string sql)
        {
            OpenDB();
            SqlDataAdapter sda =
new SqlDataAdapter(sql, cnn);
            DataSet ds = new
DataSet();
            sda.Fill(ds);
            CloseDB();
            return ds;
        }
    }

```

4.2. System Design

The system login interface is the first window after the user opens the system. The user needs to input his user name and password to enter the system.

If the password is empty or input error is illegal access, the system will pop up a dialog box to prompt.

After successful login, the main menu interface contains "system management", "basic information management", "in-storage management", "out-storage management", "inventory management" and "function assistant" buttons.

Because in the enterprise, employees perform their own duties, so we design permissions for different levels of employees. On the one hand, it can achieve the accuracy of work, on the other hand, it also improves the efficiency of processing work. The functions of each part of the system are different, but there is no difference in the main interface. The functional design diagram is shown in Figure 3.

1) System management

System management refers to the modification or management of the system due to the need of work, mainly for the new role. The new role is mainly used for system staff management, which is convenient to increase the number of system users.

2) Basic information management

Basic information management refers to the management functions related to daily warehouse management and business transactions, mainly including the following aspects:

A. Material information management

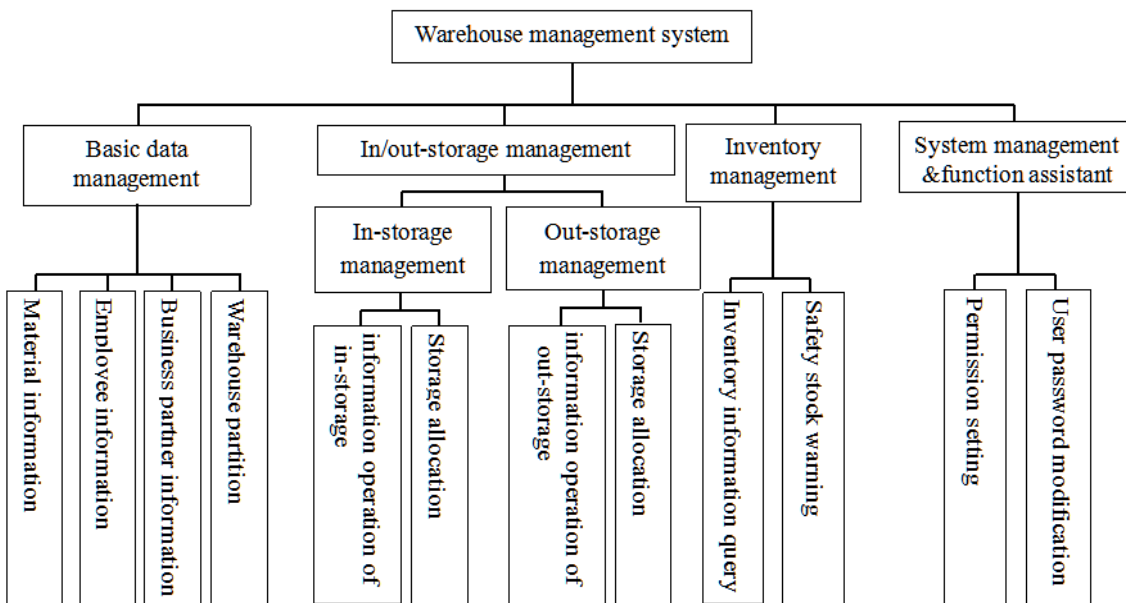


Figure 3: The functional design diagram.

Material information management is mainly used for the management of warehouse products. You can view the products in the system in the displayed table, add and delete new materials, and modify other materials.

Among them, the safety stock is analyzed for L company as follows:

Safety stock, also known as safe storage, is the expected insurance reserve in order to prevent the increase of temporary consumption or delivery delay and other special reasons. The purpose of setting safety stock is as follows:

- a. In order to avoid long purchasing period, safety stock can quickly respond to customer's order and improve order delivery rate.
- b. Setting safety stock can meet the order demand of different customers.
- c. It can optimize warehouse management - location management.
- d. Setting safety stock can optimize logistics and storage cost.

According to the previous analysis, we classified the inventory products of First Warehouse of L company by ABC according to the sales volume of the products, so as to determine the layout of the products in the warehouse. After determining the ABC level of the material, the inventory is made according to the ABC level. Among them:

Class A materials: generally, the cost is relatively high. For example, the cost of the screw thread steel accounts for about 65% of the total material. The regular order method can be adopted. There is no stock or only a small amount of safety stock as far as possible, but the quantity is strictly controlled.

Class B materials: they belong to the medium cost, can use the method of economic quantitative procurement, set a certain safety stock.

Class C materials: they have the least cost and do not need to set up safety stock. It can determine the purchase quantity for them according to the lowest point of the sum of purchase cost and inventory cost.

The sales volume and inventory of First Warehouse in the first quarter of 2020 are shown in Table 9, the sales of various steel products are shown in Table 10.

Table 9: Sales of First Warehouse in the first quarter of 2020.

Warehouse	Delivery Volume (10000 tons)	Inventory Volume (10000 tons)
First Warehouse	104154.117	56911.928

Table 10: sales volume of steel products in the first quarter of 2020.

Product Name	Sales Volume(10000 tons)
high-speed wire rod	801.98
screw thread steel	101029.49
coiled reinforced bar	1229.02
hot-rolled steel channel	145.82
hot rolled I-beam	281.22
hot-rolled angle steel	20.83
wire rod	374.95

Among them, A-class product is screw thread steel, while high-speed wire rod, coiled reinforced bar and wire rod are B-class products, so a certain safety stock should be set. There is no need to set safety stock for hot-rolled steel channel, hot rolled I-beam, and hot-rolled angle steel of class C commodity.

Calculation formula of safety stock:

$$S = M \times (T_1 + T_2) + S_0 \quad (1)$$

Where s is the safe storage, M is the average consumption per day or week, T_1 is the order processing period, T_2 is the supplier's overdue period, and S_0 is the daily safety stock.

Because L company adopts the operation mode of "base + platform", which is similar to the third-party trading platforms such as TaoBao and JingDong, the order processing period can be taken as 2 days. The supplier's late delivery period refers to the date when the supplier delays delivery. Due to many factors, such as the supplier's order processing period and the time on the way to delivery, the supplier's late delivery period is set at 5 days at most.

For the convenience of calculation, we can set the daily safety stock as 1.5-1.8 times of the daily demand.

Safety stock alert setting is reflected in the system. If the inventory is less than the set safety stock, the system will pop up the safety stock alert, indicating that the inventory will not meet the demand and need to purchase.

B. Employee information management

Employee information management module, as the name suggests, is used for the management of employees related to warehouse management, mainly including regional manager, warehouse storage management personnel, warehouse management personnel, etc. In addition, the module can query, add, modify and delete the related information of each employee.

Business partner management refers to the information management of business partners who have business relations with enterprises. Business partners include suppliers and customers. Users can query the relevant information of business partners in this module, and can add, modify, delete and other functions.

C. Warehouse partition management

L company uses the "platform + base" mode of operation, warehouse as a base, plays an important role in the whole logistics process, ABC products have been simply divided, can further improve the efficiency of logistics.

In the layout planning of the warehouse, in order to make the warehouse division reasonable, class A products should be planned near the door and aisle, while class C products should be planned at the corner, and class B products should be between the two. The product partition table is shown in Table 11.

3) in-storage-out management

Taking out-storage management as an example, it is used for information management of product delivery. The functions of this module include adding delivery information, modifying delivery information, deleting delivery information and querying delivery information.

When the stock quantity is not enough or the stock quantity will be lower than the safety stock, the system will remind users.

Taking inventory query as an example, inventory query is mainly used to facilitate the viewing of inventory status, timely replenishment, and warehouse inventory. The query mode is divided into query by sales volume, query by product, and query by business partner.

Table 11: Product storage location distribution.

Product classification	Product Name	Storage location
Class A	screw thread steel	Near the door and aisle
Class B	B1—coiled reinforced bar	Near the entrance
	B2—high-speed wire rod	Moderate storage
	B3—wire rod	Away from the entrance
Class C	C1 hot rolled I-beam	Forward position
	C2 hot-rolled steel channel	Moderate position
	C3 hot-rolled angle steel	The most corner position

4) Function assistant

The password can be modified in the function assistant. Modify password is used for system personnel to modify their password when they log in.

This system adopts the operation method of authority, the login account is: 01001, the password is: 01001, this account is the account of the super administrator of the system, you can modify the password after entering the system.

5. Summary

This system is a warehouse management system based on C # language, visual studio and SQL server for L company, which is the basis of realizing intelligent warehouse. In terms of function, it can meet a series of activities of warehouse management. The overall design is relatively perfect. It can effectively connect to the database, facilitate the administrator to call and view the data at any time, timely warn the inventory quantity, avoid the sales loss caused by shortage, and the operation is simple and convenient. It can help enterprises manage effectively and improve the efficiency of warehouse management. However, there are still some deficiencies in the design of this system, such as the poor versatility of the system function, the temporary inability to process orders, and the function of inventory analysis to generate charts has not yet been realized, which will be further optimized in the follow-up study.

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