

## **Research on Inventory Management of Tobacco Materials in Guizhou Province based on RFID Technology**

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### **Abstract**

*In recent years, RFID technology has been widely applied to the logistics system in foreign tobacco industry, and leading the information revolution within the industry, and it is imperative to use the RFID technology to design and develop the advanced tobacco materials storage management system, so we take the Guizhou Province tobacco companies as an example to design a inventory management system of tobacco materials during tobacco production using the RFID technology in this paper, in order to provide guidance and reference for the relevant sector decisions. Based on analyzing the demand of the warehouse management system of tobacco materials, we proposed the processes of tobacco materials inventory management based on RFID technology including management of basic information, entering-warehouse management of tobacco materials, inventory management and out-of-warehouse management of tobacco materials. Finally, the structure of tobacco materials warehouse management system was proposed based on RFID technology including the main interface, basic data management module, tobacco materials storage operation management module, tobacco materials inventory operations management module and tobacco goods out of library operations management module.*

**Keywords:** *RFID technology; Demand analysis; Process Designing; Warehouse Management*

### **1. Introduction**

Tobacco as an important industry in Guizhou for a long time, the tax is increasing every year, so it is important to strengthen the management and supervision of tobacco materials to ensure its effective supply during tobacco production. In the survey, we found that tobacco companies' tobacco goods warehouse management model also relies on artificial management in Guizhou Province, so there exists many issues such as long operation time, low efficiency of information transmission, high error rate and so on, but the emergence of RFID technology can solve the above problems effectively.

At present, domestic and foreign scholars have done a lot of research on the development of RFID and its application in tobacco warehouse management. From the applications of RFID abroad, the United States is the promoter of applications of RFID technology. RFID technology industry is mainly concentrated in the more mature in the European market currently, in the aspect of software, the traditional Microsoft, IBM, Oracle and SUN companies invested huge and own advantages obviously in RFID middleware. In academic research, foreign researchers mainly focused on RFID data management, the architecture and designing of RFID information system, and the application of RFID technology. Youngbong Kim et al designed an RFID application framework of RFID; Zaheeruddin ASif and Munir Mandviwalla established a human resources model and functional utility model, Asghar Sabbaghi and Ganesh Vaidyanathan analyzed the RFID technology for the field of logistics supply chain to bring efficiency from the aspects of value chain analysis and policy analysis. Markus Nuttgens Jan Mendling studied the application of EPC system markup language and EPML modeling technology in supply chain links. Michael R. Liu, QL Zhang and Lionel M.

Ni, etc. proposed the algorithm group of order service based on multi-agents based on RFID. In recent years, the application of RFID technology in the tobacco industry has also made rapid progress, and the RFID technology has been used into the logistics system of tobacco industry in the foreign leading to the information revolution within the industry.

The research on the application of RFID in the tobacco warehouse in China is later, but using the RFID technology to build logistics information system is also increasing in recent years along with the increasing requirements of the automation of tobacco industry, such as cigarette factory in Hangzhou, tobacco company distribution center in Kunming, tobacco company in Chongqing, tobacco company's logistics center in Shanghai all have used RFID technology in logistics management in different levels and also have achieved some results. In academic research, Deng Ke designed RFID platform for mobile clients by combining the RFID technology with SOA and mobile networks and. Sun Guangfu applied the RFID technology to the process of production, distribution and transportation of the logistics.

In summary, the RFID technology has been widely used in the logistics system and has made considerable progress in the tobacco industry, therefore, it is imperative to use the RFID technology to design and develop advanced tobacco warehouse management system, and it can reduce management costs effectively and improve management efficiency. So we take Tobacco Company of Guizhou Province as an example to design a warehouse management system of tobacco materials based on RFID technology hoping to provide guidance and reference for the relevant sector decisions.

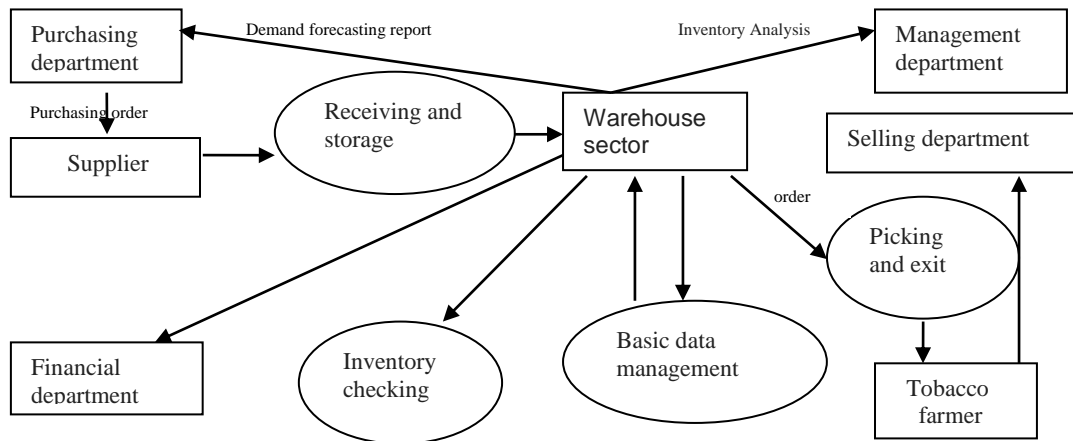
## **2. Demand Analysis of Inventory Management System of Tobacco Materials Based on RFID**

During the survey of tobacco materials management in Guizhou Province, we found that the mainly problem of the storage management of tobacco materials is low efficiency of information transmission system. Therefore, in order to solve the above problems of tobacco materials management and to achieve the functioning of the material storage effectively, as well as trying to maintain the current existing warehouse operation model at the same time, we proposed a storage management optimization system of tobacco materials based on RFID. We thought that the system should meet the demands of the following aspects according to analysis of the actual storage management process of tobacco materials:

- (1) The system should have the functions of information management system, such as rights management, data query, statistics and management;
- (2) The system can improve the accuracy of the query of tobacco materials;
- (3) The system can improve the quality of inventory operations of tobacco materials;
- (4) The system can help reducing the cost of the inventory management of tobacco materials;
- (5) The system can provide warnings automatically when the inventory of tobacco materials below the quantity of safety stock;
- (6) The system can accelerate the speed of cigarette supplies out of storage to increase the throughput of warehouse;
- (7) The system can offer information on tobacco materials inventory accurately and timely to managers and decision-makers;
- (8) The system can collect the inventory information of tobacco materials automatically to realize paperless operation on the inventory management of tobacco materials.

### 3. Designing of the Storage Management Process of Tobacco Materials Based on RFID

Here, the main activities of the storage management of tobacco materials includes: basic data management, entering-warehouse management, inventory management and out-of-warehouse management. System flowchart was shown in the Figure 1.



**Figure 1. Overall Flowchart of Tobacco Material Storage Management**

After the purchasing department of tobacco company sending purchasing order to tobacco materials suppliers, the suppliers will arrange for delivering, and the warehouse department of cigarette station will arrange for entering-warehouse of tobacco materials as well as sending the entering-warehouse documents to the financial sector after the procedures of quality testing and verification through provincial tobacco companies, city's tobacco companies, county's tobacco companies, and tobacco station. Of course, the warehouse department needs to check inventory regularly, and it should update the data and send them to finance department to adjust inventory information when the checking data is differ from the inventory data. Finally, the selling department will send these tobacco materials to tobacco farmers and nursery specialist according to selling information which is approved by superiors.

#### (1) The process of the entering-warehouse of tobacco materials

Here, there are four ways for the entering-warehouse of tobacco materials, including acceptance, shift, liter overflow and returns. The main flow of the entering-warehouse of tobacco materials is shown in figure2:

1) Warehousing department accepted and verified the suppliers' ship notices, and then, warehousing department will verify notification and entering-warehouse plan approved by provincial tobacco companies.

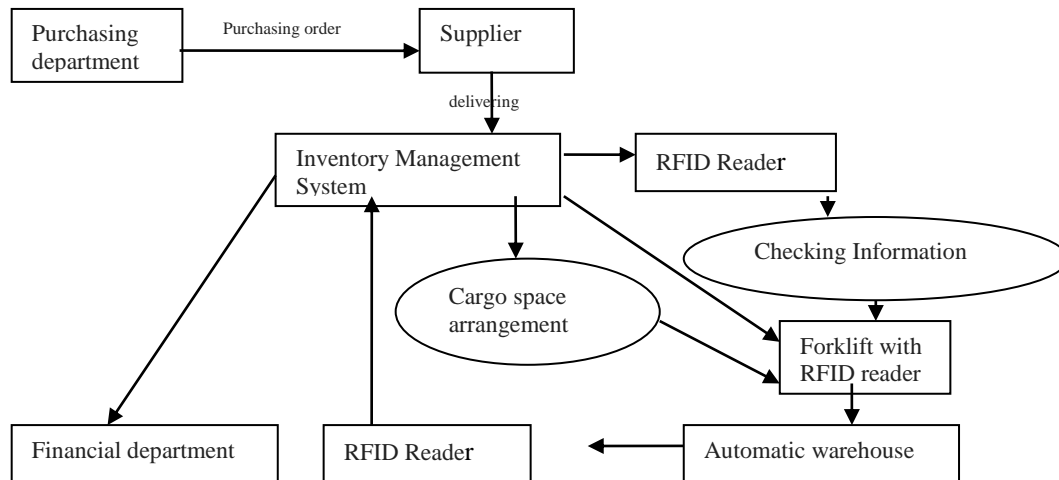
2) Warehouse management system allocated storage area and storage location for the materials according to the type and quantity of materials.

3) Fixed RFID reader reads cargo label at storage door and collects the materials information when the tobacco materials arrived in the tested area which is confirming the entering-warehouse quantity and verifying the purchase notice.

4) When the check is correct, the warehouse management system retrieves the idle truck through the wireless network, and sends the job instruction and location of tobacco materials.

5) The entering-warehouse devices brings the tobacco materials to the shelves according to the placement of tobacco materials.

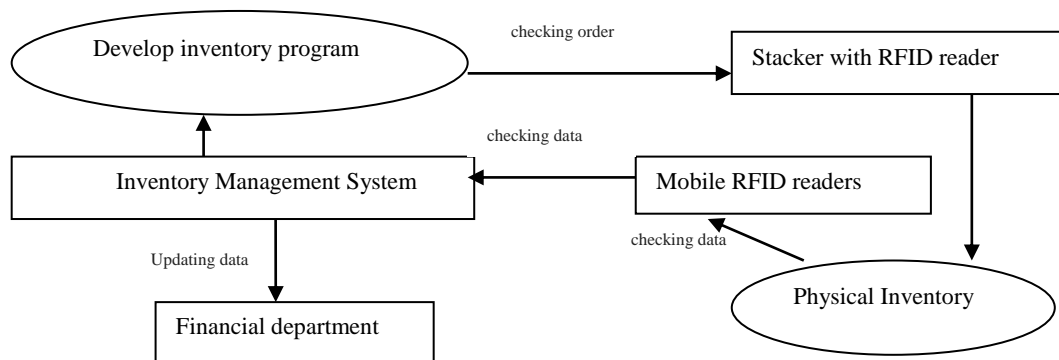
6) entering-warehouse department sends the processing results to the underlying database via handheld reader.



**Figure 2. Flowchart of the Entering-Warehouse of Tobacco Materials**

(2)The inventory process of tobacco materials

The checking of warehouse is to verify the quantity of the warehouse inventory. Its business processes is shown in Figure 3:



**Figure 3. Inventory Flowchart of Tobacco Materials**

- 1) Select the warehouse inventory, reservoir, etc;
- 2) Making the inventory list, generate inventory lists;
- 3) Stacking machine positioned to require cigarette inventory position

After materials management system to control the reader starts reading data through a wireless network;

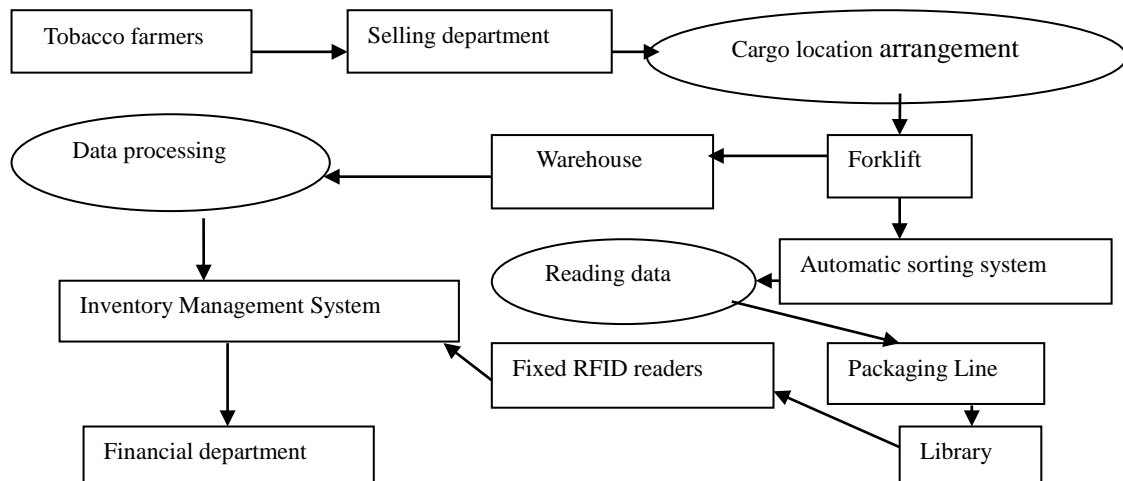
4) The reader through the wireless network inventory data (the actual number of warehouse storage of goods) to the background management system;

5) System inventory process to calculate the overflow quantity of goods warehouse inventory loss.

(3) Processes of tobacco materials out of the library

The out-of-warehouse processes of materials is mainly sorting and managing the out-of-warehouse of the tobacco materials according to the out-of-warehouse note. Its business processes shown in Figure 4.

- 1) Warehouse system selects the tobacco farmers after receiving the supply plan verified by provincial tobacco company.
- 2) Inventory controlling system computes the cargo location of tobacco materials according to the out-of-warehouse principle, and prints out the out-of-warehouse note or out-of-warehouse order.
- 3) Forklift acquires the tobacco materials in the posited location.
- 4) Sending the operation results to the inventory management system by wireless network using mobile devices or fixed RFID readers.
- 5) Delivering the sorted materials to the automatic sorting system.
- 6) The automatic identifying device installed on the automatic sorting system reads the RFID tag during the moving process of the tobacco materials.
- 7) The moving device scans and tests the information of tobacco materials when they are transported to the out-of-warehouse door.



**Figure 4. Out-of-Warehouse Process of Tobacco Materials**

#### **4. Architecture of Warehouse Management System of Tobacco Materials based on RFID**

- (1) The function target of the warehouse management system of tobacco materials

1) To meet the automatically requirements of entering-warehouse, storage, checking, moving, out-of-warehouse, sorting and distribution of tobacco materials.

2) Changing the defects of management cumbersome and overworked job in traditional warehouse management to improve the operational efficiency and meet the increasing demands of warehouse workloads.

3) To achieve visual supervision and management is a very necessary function for warehouse management system of tobacco materials, visualization of warehouse management allows staff works faster, controlling the tobacco materials moving accurately and hope to improve warehouse management level.

4) Simplify the system processes to realize querying and analyzing a number of input data of products and inventory data quickly.

5) Providing the inventory information of tobacco materials (including inventory warning information) at any time.

(2) The architecture of warehouse management system of tobacco materials

1) The main interface of system

We can enter into the main interface of the system after the certification of user permissions (as it is shown in the Figure 5). In the main interface, the user can use different permissions for different functions in the main interface, the upper part of the main interface has the menu, the dynamic icons in the middle are some shortcut buttons of common functions, we can enter into the different modules function interface after tapping it. And the main interface is mainly consists of the functions about plan management, entering-warehouse management, inventory management, out-of-warehouse management, adding basic data and system management.



**Figure 5. The Main Interface**

2) Management module of basic data

The management module of basic data of warehouse management system is responsible for adding the original information and establishing the database based on RFID, such as basic information of tobacco farmers, the cultivation situation of farmers, cooperatives information of farmers, information of materials warehouse (as it is shown in the Figure 6).



**Figure 6. Management Modules of Basic Data**

In actual operation, we enter the information about cooperatives information of farmers and materials warehouse, and then, we enter the information about tobacco farmers, finally, we enter the information about the cultivation situation of farmers.

### 3) Entering-warehouse management module of tobacco materials

The entering-warehouse management module of tobacco materials includes entering-warehouse of verified materials, entering-warehouse of shifted materials, entering-warehouse of storage of returned materials and entering-warehouse of overflowed materials.

Entering-warehouse module of accepted materials includes materials selection, bar code printing, drawing up and inquiry of entering-warehouse note of verified materials (as it is shown in the Figure 7).



**Figure 7. Entering-Warehouse Module of Receiving Materials**

Specific operations explanations are as follows:

Clicking the menu of "procurement plan number" after entering into the module, and there will appear material barcode in the right bottom, and printing the barcode and stick into the entering-warehouse materials. At the same time, we should pay attention to check whether the bar code is the same to the actual storage warehousing materials.

Entering into the menu of "drawing up entering-warehouse note of materials ", and inputting the relevant information, and then returned to the menu of "material selection and bar code print" to select the planed entering-warehouse number and inputting the quantity of entering-warehouse materials selected and saved.

Selecting a single number for inquiring, and can print the generated entering-warehouse note.

Entering-warehouse module of moving materials includes shift library materials selection, open acceptance of shift library materials, shift library acceptance of inquiry (as it is shown in the Figure 8). Specific operations explanations are as follows:

Clicking the button of "planed number of moving materials ", and there will appear related information about moving plan below.

We can draw up the receiving note after clicking the button twice.

Returning module of materials mainly contains the farmer selection, nursery specialist selection, returning details of materials, and the query function of returning materials (as it is shown in the Figure 9), Specific operations explanations are as follows:

Selecting the farmers or nursery specialist needing to return the materials, and the program will return to returning note automatically.

We can input the quantity of returning materials after inserting the reason for returning and pressing the "Enter" button.

移库计划编号	物资品名	规格	移库计划量	计量单位	辅助单位	换算关系	已入库量
2010032101B010102010100103	南部烟肥	10: 10: 40	6000.00	公斤	袋	50.000	1395.00

Figure 8. Moving and Receiving Module of Materials

流水号	物资名称	注意	单位	成本单价	供应数量	退货数量
101B01100000101	01020101001		40	公斤	60.00	250.00
101B01100000201	01020101001		40	公斤	60.00	10.00
101B01100000202	01020101001		40	公斤	60.00	15.00
101B01100000301	01020101001		40	公斤	60.00	10.00
101B01100000302	01020101001	南部烟肥	10: 10: 40	公斤	60.00	5.00
101B01100000401	01020101001	南部烟肥	10: 10: 40	公斤	60.00	20.00
101B01100000601	0102010100120100227	01020101001	10: 10: 40	公斤	60.00	100.00
101B01100000701	0102010100120100227	01020101001	10: 10: 40	公斤	60.00	20.50
101B01100000801	0102010100120100227	南部烟肥	10: 10: 40	公斤	60.00	60.00
101B01100000901	0102010100220100214	北部烟肥	10:4:2	公斤	555.00	400.00
101B01100001001	0102010100220100214	北部烟肥	10:4:2	公斤	555.00	30.00

Figure 9. Entering-Warehouse Module of Returning Materials



The entering-warehouse module of overflowing materials includes the functions of drawing up the overflowing note, the details of the overflowing note and inquiring the overflowing note (as it is shown in the Figure 10). Specific operations explanations are as follows:

Clicking the “Insert” button and inputting relevant information about the people who checking the overflowing inventory. And then clicking the button of “detailing note of overflowing materials”.

Inputting the quantity of the overflowing materials and saving it, and then we complete the entering-warehouse operation of the overflowing materials.



物资条形码	品名	规格	单位	单价	数量	升溢数量
0102010100120100227	南部烟肥	10: 10: 40	公斤	60.00	804.00	0
0102010100120100228	南部烟肥	10: 10: 40	公斤	60.00	1000.00	0
0102010100120100302	南部烟肥	10: 10: 40	公斤	60.00	6.00	0
0102010100220100214	北部烟肥	10:4:2	公斤	555.00	3390.00	0
0102010100220100215	北部烟肥	10:4:2	公斤	555.00	200.00	0
0102010100120100303	南部烟肥	10: 10: 40	公斤	60.00	130.00	0
						0.00

Figure 10. Entering-Warehouse Module of Overflowing Materials

#### 4) Inventory management module of tobacco materials

Inventory management module of tobacco materials contains the query of materials inventory, the checking of materials inventory and the warning of materials inventory. Among them, the query of materials inventory is mainly used to query the existing inventory (as it is shown in the Figure 11); the checking of materials inventory can check the existing inventory, and print inventory table (as it is shown in the Figure 12); the warning of materials inventory can be early warning according to the validity and quantity of materials (as it is shown in the Figure13).



物资条形码	品名	规格	单位	单价	数量	成本金额	销售单价	备注
0102010100120100227	南部烟肥	10: 10: 40	公斤	60.00	804.00	48240.00	90.00	
0102010100120100228	南部烟肥	10: 10: 40	公斤	60.00	1000.00	60000.00	90.00	
0102010100120100302	南部烟肥	10: 10: 40	公斤	60.00	6.00	360.00	90.00	
	小计:				1810.00	108600.00		
0102010100220100214	北部烟肥	10:4:2	公斤	555.00	3390.00	216904.00	22.00	
0102010100220100215	北部烟肥	10:4:2	公斤	555.00	200.00	32323.00	22.00	
	小计:				3590.00	249227.00		
0102010100120100303	南部烟肥	10: 10: 40	公斤	60.00	130.00	7800.00	90.00	
	小计:				130.00	7800.00		
	合计:				5530.00	365627.00		

Figure 11. Query of Materials Inventory

**物资库存盘点**

物资条形码	品名	规格	单位	单价	数量	成本金额	有效期限	盘点数量
0102010100120100227	南部烟肥	10: 10: 40	公斤	60.00	804.00	48240.00		
0102010100120100228	南部烟肥	10: 10: 40	公斤	60.00	1000.00	60000.00		
0102010100120100302	南部烟肥	10: 10: 40	公斤	60.00	6.00	360.00		
				小计:	1810.00	108600.00		
0102010100220100214	北部烟肥	10:4:2	公斤	555.00	3390.00	216904.00		
0102010100220100215	北部烟肥	10:4:2	公斤	555.00	200.00	32323.00		
				小计:	3590.00	249227.00		
0102010100120100303	南部烟肥	10: 10: 40	公斤	60.00	130.00	7800.00		
				小计:	130.00	7800.00		
				合计:	5530.00	365627.00		

Figure 12. Checking of Materials Inventory

**物资库存预警**

在库时间预警 有效期预警 库存量预警

物资条形码	品名	规格	单位	单价	数量	成本金额	销售单价	在库时间(天)
0102010100220100214	北部烟肥	10:4:2	公斤	555.00	3390.00	216904.00	22.00	18
0102010100220100215	北部烟肥	10:4:2	公斤	555.00	200.00	32323.00	22.00	17
0102010100120100227	南部烟肥	10: 10: 40	公斤	60.00	804.00	48240.00	90.00	5
0102010100120100228	南部烟肥	10: 10: 40	公斤	60.00	1000.00	60000.00	90.00	4
0102010100120100302	南部烟肥	10: 10: 40	公斤	60.00	6.00	360.00	90.00	2
0102010100120100303	南部烟肥	10: 10: 40	公斤	60.00	130.00	7800.00	90.00	1
				合计:	5530.00	365627.00		

Figure 13. Warning of Materials Inventory

#### 5) out-of-warehouse management module of tobacco materials

The out-of-warehouse management module of tobacco materials contains selling module and out-of-warehouse module. And the selling module of materials includes the functions of the selection of tobacco farmer and nursery specialist, selling materials and progress query of selling materials (as it is shown in the Figure 14), the specific operation explanations are as follows:

Clicking to select farmers or nursery specialist, and the program will go to the module of selling materials automatically.

Selecting the way of payment and selling according the approved material information.

The information has been input can not be changed after clicking the buttons of “increase materials”, but can increase again after be removed.

We can find the selling note according to note number.

Detailed selling information about farmers or specialist can be found in the selling progress module.

**物资销售**

选择商品 选择商品专业户 **销售物资** 物资销售查询 销售进度查询 供应总体情况报表

流水号: 201032101B011000018  
 微机号: 2010032101B010002 姓名: 李四  
 付款方式: 销售时间: 2010-03-04  
 购进金额: ¥0.00 销售金额: ¥0.00  
 备注:

物资代码	单位	数量	已供数量	供应面积	单位	品名
01020101001	公斤	4913.00	310.00	12.00	公斤	南部烟肥
01020101002	公斤	7930.00	0.00	3.00	公斤	北部烟肥

物资名称 品名(\*) 单位 购进基价 销售基价 数量 供应面积(亩) 供应标准 品名

增无条码物资 增条码物资 删除新增物资 生成报表

**Figure14. Module of Selling Materials**

The module of shift and out-of-warehouse of materials contains the functions of the selection of shift note, query of out-of-warehouse and shift of materials (as it is shown in the Figure 12), the specific operation explanations are as follows:

Clicking the number of shift program, and the program will go to the out-of-warehouse module automatically and generating the shift note.

The program will determine whether the material is controlled by the bar code by taking the shift information as the shift condition.

**物资移库**

选择移库单 物资出库 物资移库查询

流水号: 201032101B011000002  
 入库单位名称: 陈溪 出库单位代码: 032101B01  
 承运单位: sdf 车号: sdf sdf  
 操作人: admin 发货时间: 2010-03-04

物资代码	单位	数量	已供数量	供应
03260102010		6000.00	0.00	

物资名称 品名(\*) 单位 购进基价 销售基价 数量 供应面积(亩) 供应标准 品名

增无条码物资 增条码物资 删除新增物资 生成报表

**Figure 15. The Module of Shift and Out-of-Warehouse of Materials**

## 5. Conclusions

As the latest results of the development of radio frequency identification technology, RFID technology shows the huge market potential owing to the advantages of supporting fast read and write, non-visual recognition, movement recognition, multi-targets recognition and positioning, and it can enhance the efficiency of the production, storage, processing, transportation and other aspects during the process of supply chain. so we take the Guizhou Province tobacco companies as an example to design a inventory management system of tobacco materials during tobacco production using the RFID technology hoping to provide guidance and reference for the relevant sector decisions in this paper. Based on analyzing the demand of the inventory management system of tobacco materials, we proposed the processes of tobacco materials inventory management based on RFID technology, and then the structure

of tobacco materials warehouse management system was proposed based on RFID technology.

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