

RESEARCH AND DEVELOPMENT OF PURCHASE MANAGEMENT SYSTEM FOR CHINESE MEDIUM AND SMALL MANUFACTURING ENTERPRISES

JIA Zhenyuan, LU Xiaohong, JIA Defeng, LV Yuanzhe

Key Laboratory for Precision and Non-traditional Machining Technology of Ministry of Education, Dalian University of Technology, 116024, Dalian, China

Corresponding author: Lu Xiaohong E-mail: xiaohonglu@yahoo.cn

As there is no purchase management system suitable for Chinese medium and small manufacture enterprises, a purchase management mode adapted to Chinese medium and small manufacture enterprises is proposed and a purchase management system with the core of order is developed based on the product structure, the enterprise situation and the current information management situation of Chinese medium and small manufacture enterprises. The standardization of a series of processes such as applying purchase, order, purchase inspection, qualified products warehousing, etc. is achieved. Through the development design of design BOM, the purchase BOM is designed and the basic functions of MRP are achieved, and then the efficiency and accuracy of the purchase plan are enhanced. The application results have proved that the designed purchase management system has a good practical application effect.

Keywords: purchase management system, medium and small manufacture enterprises, China, order

(Received 19 Oct 2009; Accepted in revised form 9 Oct 2010)

1. INTRODUCTION

The purchasing department is the major department of a medium and small manufacture enterprise. Krause, Daniel R. et al. (Krause, Daniel R. et al., 2001) asserted that purchasing is a strategic contributor to the firm. Purchasing, an essential part of the enterprise operation, holds the balance in enterprise development (WANG Yuhua et al., 2008), which is in charge of the management of supply, because nearly all the production activities begin from this department, and the purchasing raw material cost occupies a large proportion of the production cost. Purchasing, as the initial part of the production and operation activities of manufacturing enterprise, directly impacts on the production and management processes, corporate performance, and constitutes an important aspect of the competitiveness of enterprises. Purchasing management, as an important component of logistics and capital flows, plays an important role in ensuring the normal flow of information and delivery deadline, lower costs etc. (Xie cuiping et al., 2007). The formulation of purchase plan is a time-consuming and laborious work, the staff of purchasing department often makes wrong orders because of the unpractical analysis of purchasing, hence causes unnecessary losses to the enterprise (Cai Jie et al., 2007), therefore, an effective corporate procurement management information system can greatly enhance the work efficiency of purchasing department and reduce costs.

Shimazu, Hitoshi and Okajima, Hiromi (Shimazu, Hitoshi and Okajima, Hiromi, 1996) developed a planning and purchasing management system. In the process of this system development, the client/server system had been established with an expanded information network and the downsized computer processing. Chen, Injazz J. et al. (Chen, Injazz J. et al., 2004) examined the links among strategic purchasing, supply management, and firm performance. Cai Lili, et al. (Cai Lili et al., 2006) analyzed the difference between the traditional procurement and the procurement under the condition of supply chain environment, gave a selection and evaluation model of supplier by using the Analytic Hierarchy Process (AHP) method, and proposed a design plan of ERP purchasing management system based on the manufacturing supply chain. Zhang YiDe et al. (Zhang yide et al., 2003) introduced the design features and key enabling technologies of the purchase operations management information system from the perspective of engineering implementation. Chen Ke and Yuan Anfu (Chen Ke and Yuan Anfu, 2009) put forward a development project of management information system based on object-oriented analysis and the function characteristics of purchasing management. In the development process, ADO object interface technology was used to achieve remote access to the database, data acquisition and data updating, which overcomes the difficulties that large packages were used to organize the system and the whole MIS update was difficult in the traditional ODBC API interface development process.

However, the purchasing cost increases because most of Chinese medium and small enterprises belong to small batch production type. The small enterprise scale and little circulating fund often lead to the situation that purchase quantity isn't enough, sometimes even the production supply can not be ensured. The problems existed in the purchasing management of Chinese small and medium-sized manufacturing enterprises are summarized as follows:

- 1) Long procurement cycles, complex procurement processes, slow information transmission, cumbersome procurement-related documentation and manual operation; supply is not timely.
- 2) The procurement quality has no guarantee. Buyers select suppliers mainly based on the high and low prices, while ignoring the evaluation of the supply quality. Usually, the quality problems are controlled after the procurement.
- 3) Poor supervision control, coexistence of material overstock and shortages.
- 4) The formulation of procurement plans lacks of scientific method. Before the implementation of production management information system of the enterprise, there is not a strict constraint relationship between procurement plan and production plan. The formulation of procurement plans is entirely the results of the buyers' experience. Once the

procurement plans staffs are changed, the procurement operation of enterprise will be influenced greatly. This is inconsistent with generally accepted MRP idea, much less in accord with the philosophy of JIT.

5) Poor information sharing. As the various kinds of data management are paper management, or the data simply exist in the makers' personal computer and has no network transmission, information sharing is poor. Because information is scattered, the query of data is extremely inconvenient, which leads to serious information lag, so that production departments do not know how much material are available for production; warehouse do not know what the purchasing department had purchased; Purchasing department are also unclear whether the last month's purchasing materials are arrived, this greatly affects the implementation accuracy and efficiency of the various production activities (Hu Dongwei et al.,2007).

6) The low level of employee's information technology, which still rests on the stage of using Word, Excel and other basic office software. This is one of the key issues that must be solved by training in the informationization process of Chinese small and medium manufacturing enterprises.

In view of the above problems in purchasing management, it becomes essential to establish a set of procurement management information system which adapt to the characteristics of small and medium manufacturing enterprises.

From the information perspective, the cross operation of purchase plan and verbal order makes buyers not know what goods have been ordered until they got the statistical results of the arrival goods. It is possible that the supplying company supplies goods not on the order, ordered 5000 units, but arrived 7000 units; even there exists an order fax. Thus the conflict between purchase plan and the actual condition leads to waste of funds. Furthermore, the debt among cooperative enterprises and some man-made factors often lead to the arrival of nonconforming products. From the perspective of enterprise management, Buyers can often get benefits from the suppliers, so the purchase department is regarded as the most profitable department by many people, and most buyers do not hope to make the purchasing information transparent, which brings many resistances to management.

Based on the research of lots of Chinese medium and small manufacture enterprises, this paper sets out to build a purchase management model suitable for Chinese medium and small enterprises, develops a purchase management system, and achieves the targets of purchase management informationization, purchase flow standardization, and purchase data transparency. According to the results of the designed purchase management system, the enterprise leaders can find out the practical purchase situation in time, and then the reasonable arrangement for funds and enterprise's sustainable development can be achieved.

2. DEMAND ANALYSIS

2.1 The Overview of Purchase Department Personnel Roles

Generally, the purchase department of Chinese medium and small manufacture enterprises consists of the following post holders:

- 1) Buyer: In charge of the daily purchase, contacting suppliers and purchasing materials and equipments, filling in the relevant order table, the declaration form, and the material issue note of back goods, and so on;
- 2) Planner: According to monthly Production capacity plan, making monthly purchase plan considering the product inventory, BOM and safety stock; For the middle additional production capacity plan, deriving an additional purchase plan;
- 3) Purchasing Supervisor: Auditing the daily order, purchase plan, additional purchase plan, etc.; supervising the purchase situation, the arrival goods status and the warehouse situation; guaranteeing the normal supply of the enterprise production;
- 4) Deputy purchase manager: In charge of checking purchase plan and orders, and so on;
- 5) Production planner: Inputting the monthly production capacity plan and the additional production output plan;
- 6) Checker: checking goods, and filling in the check list; giving checking opinions of the arrival concession goods;
- 7) Warehouse keeper: Checking warehouse entry, moving and discharge situation;
- 8) Financial staff: Managing invoices and financial affairs according to warehouse entry and discharge situation;
- 9) Production minister: Proposing the application form of the concession acceptance;
- 10) Technology department manager: Checking the application form of the concession acceptance;
- 11) Deputy check general manager: Auditing the application form of the concession acceptance.

2.2 Supplier Information Management

The supplier of Chinese medium and small manufacture enterprises consists of three types:

- 1) Unchecked supplier: The enterprise is testing and inspecting its production, and the purchase quantity is very small, namely that the supplier is not checked by the leader of the enterprise. In the proposed purchase management system, the unchecked supplier must be checked by the leader when it has business contact with the enterprise.
- 2) Ordinary supplier: The enterprise has performed the experiment on its production, but because of the reasons of not signing the purchase agreement or the unsteady price, the enterprise does not order in large quantity. Even if the supplier has passed the check of the purchasing supervisor, it still needs to be checked by the concerned managers when it has business contact with the enterprise.
- 3) Contract agreement supplier: The enterprise has signed a long-term supply goods agreement with the supplier and it can keep the supply goods quality and the steady price in a period of time. The supplier is checked by the concerned managers, and need not to be checked again when it has business contact with the enterprise.

The types of the supplier should be closely related with the user authorities. the above mentioned three supplier types reflects the corresponding authorities of buyers, purchasing supervisor and Deputy purchase manager, namely, the buyer can make operations such as add, modify or delete, etc. to the unchecked supplier information, but can not make operations to the other two types of suppliers. Purchasing supervisor can make operations to the unchecked supplier and the ordinary supplier, and can change the unchecked supplier into the ordinary supplier, but can not perform operations to the contract agreement supplier. Deputy purchase manager can modify any types of suppliers' information, and can change the unchecked supplier or the ordinary supplier into the contract agreement supplier.

Functions of the supplier information management module mainly include:

- 1) Price management for supplier delivery goods;
- 2) Supplier management closely related with the user authorities: buyer can add, modify or delete the information of the unchecked supplier and its supplied goods. Purchasing supervisor can change the unchecked supplier into the ordinary supplier. Deputy purchase manager can change the supplier into the contract agreement supplier. The checked supplier information only can be modified by the purchasing supervisor; the buyer can not modify it.
- 3) Supplier delivery history management: The order list situation and the check list situation of the supplied goods can be inquired.

2.3 Purchase Plan and Purchase Order Management

The formulation of purchase order has three types and their flow is shown in Fig. 1 (a), (b) and (c) respectively.

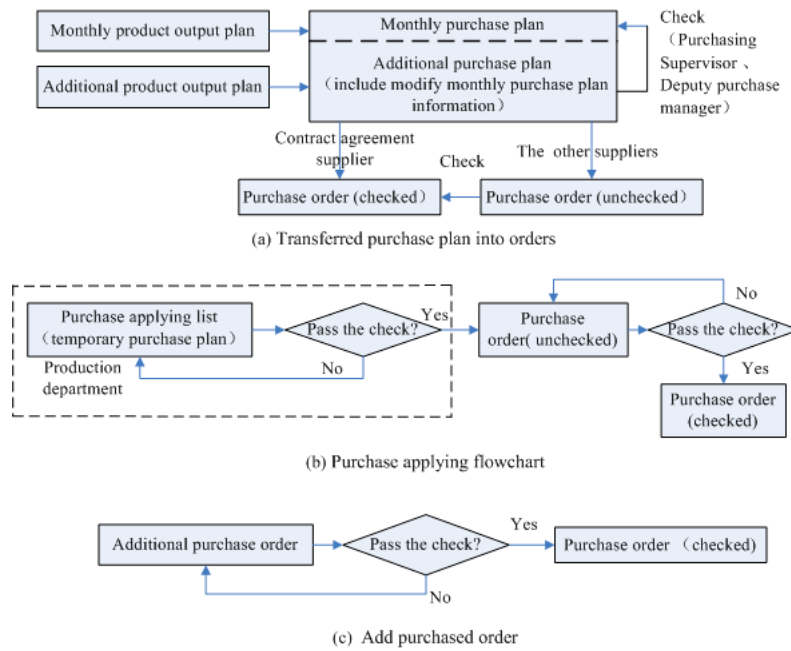


Figure 1. Three types of flow of purchase order

Fig.1 shows that purchase order can be divided into three types: transferred purchase plan (total amount does not exceed the plan amount), purchase applying list and temporary purchase order, among which the transferred purchase plan does not need to audit, while the purchase applying list and temporary purchase order need to audit. The specific management of the order is as follows:

1) Purchase plan management: Purchase plan is divided into raw material purchase plan (long-term), standard component, cooperation finished component and cooperation blank component purchase plan (the major plan), and consignable blank purchase plan (individual purchase). The purchase plan of the standard component, cooperation component and the cooperation blank is derived from the purchase plan of the purchase management system. Production planner inputs monthly production output plan or the additional production output plan, after checked by the vice general manager, it can not be changed and is turned into the audited status; purchase planner inputs the purchase plan or changes the production plan into Material Require Planning (MRP) according to the inventory, BOM and safety stock, then revises the plan according to the actual situation. After checked by the purchase minister and the purchase vice general manager, the plan becomes the formal monthly purchase plan at last. According to the additional production plan, additional purchase plan can be derived from the purchase plan, which can be reflected in the monthly production plan, and it will be carried out after being checked.

2) Turn the purchase applying list to order: The management of the purchase applying list is different from the actual operation mechanism of the medium and small manufacture enterprises: designing a new order, getting rid of the signature of buyer, purchasing supervisor and purchase vice general manager, putting the inquiry into the supply of goods information management, that is to say, the purchase applying list is separated from the purchase order. Before the purchase, buyer should check whether there is the necessary purchase information in purchase BOM, if the purchase information (generally belongs to the equipment accessories) is not exist in the purchase BOM, then buyer need to add the purchase information, the supplier and the inquiry record, after checked by the purchasing supervisor, the type of the order is changed into the transferred purchase order, which needs to be filled in the purchase department and the purchase applying number, and it can be carried out after checked by the purchasing supervisor and the vice general manager.

Due to the medium and small enterprise often appears the phenomenon that the arrival goods quantity is more than the requested quantity, it needs to establish the temporary purchasing order to deal with this situation, the temporary purchasing order can be the additional purchasing order of the arrival additional goods or the temporary needed order.

The temporary order can be converted into the formal order after signed by the purchasing supervisor and the vice general manager.

3) Management of the purchase order: The unchecked order can be modified at will, while the checked order can not be modified, but the order with floating cargo can be modified after giving up check, the checked order with arrival cargo can not be modified. The unchecked order can be deleted, the checked order with floating cargo can be deleted after giving up check, and the order with arrival cargo can not be deleted.

2.4 The Production Arrival Process

Cargo arrival flow is shown in Fig. 2. The arrival cargo must be checked. When the cargo arrived, the buyer should fill in the production declaration list (two parts: purchasing department, checking department and supplier). Production declaration list is converted from the order. Among it, the quantity declared \leq the ordered quantity-the arrival quantity, that is to say, the arrival quantity can not surpass the total purchasing quantity, no matter whether the cargo is coming in batches or once and for all. The superabundance of the arrival cargo can be checked and enters the warehouse after renewing an order (or modifying the original order).

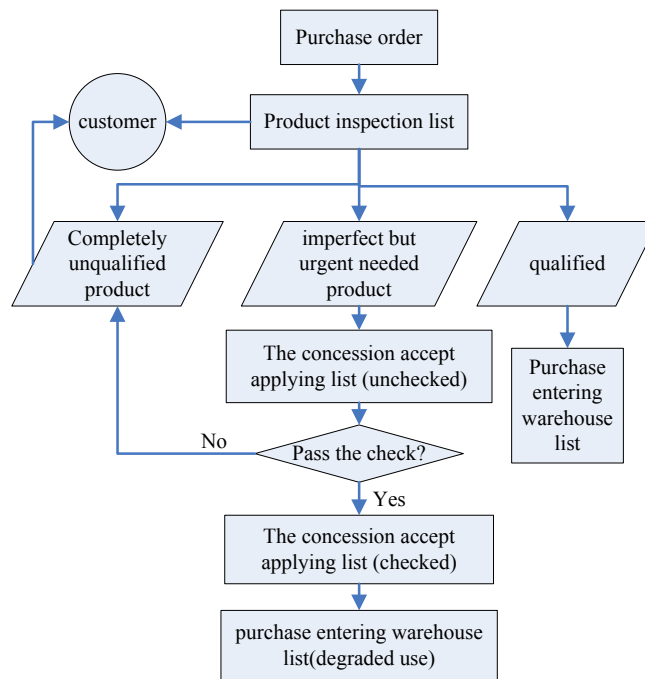


Figure 2. Purchase production arrival flow chart

1) The concession accept applying list: The medium and small enterprise sometimes appears the situation that purchased cargo is unqualified, but the production needs it urgently, usually, the concession accept applying list can be used to deal with the situation. The process flow is that: if inspector find there exist unqualified but urgent needed cargo when checking the arrival cargo, the inspector should inform the buyer, and the buyer fills in the concession accept applying list (the format refers to the concession accept list; four parts: purchasing department, checking department, production department, stock), and then the concession accept applying list must be checked by the checking department, the production department and the technical department, finally, it must through the check of the vice general manager. The concession acceptance list can not be passed if any one quality check rejects it. The approved concession accept applying list can directly be converted into the concession accept warehouse warrant.

2) Entering warehouse management: The buyer converts the finished production declaration list into the purchase entering warehouse list (three parts: checking department, purchasing department and finance department). The production quantity of the purchase entering warehouse list is taken from the qualified quantity of the production declaration list (or the concession accepts quantity); the unqualified product can not enter the warehouse and should be returned to the supplier directly. The types of warehouse entry form include the normal warehouse entry form and the concession accepts warehouse entry form. The normal warehouse entry form is converted from product declaration list, while the concession accept warehouse entry list is converted from the concession accept applying list.

2.5 Returned Purchase

When operates returned purchase, the purchaser filled in the merchandise credit slip (five parts: production department, stock, finance department, checking department, purchasing department), after the merchandise credit slip is checked by the purchasing department, finance department, inventory and vice manager, the cargo can be returned. The merchandise credit slip can not be deleted and modified after being checked, while the unchecked merchandise credit slip can be modified or deleted after giving up check.

2.6 Management of the Consigned Processing Parts

There is records of the storage of the consigned processing parts (stock of the own enterprise and the consigned processing factory) and the finished products. Purchase plan of the consigned processing parts is made according to the total quantity of the consigned processing parts inventory situation. Consigned processing release sheet is made in respective of the storage dada in the consigned processing factory. Consigned processing release sheet is similar with the other release sheet, first it is filled in by the buyer, after audited by purchasing supervisor and vice minister, it can be transferred to the warehouse keeper who will check them before ex-storage. Finance departments and production department should acquaint themselves with the ex-storage information.

3. CONCEPTUAL DESIGN OF THE DATABASE

Considering that the designed purchase management module is mainly database-oriented, it dedicates to deal with the complex relationships between data, while the concepts of object model and class are simple. The entity relationship model is designed and structured design method is applied to design the data base (Lu Xiao et al., 2005).

3.1 Data Flow Diagram Design

The essential of the structured analysis is adopting layered data flow diagram and corresponding data dictionary as the model of the system, which is a top-down modeling method that depended on data flow diagram strongly (Zhang Haifan, 2009). Data flow diagram (DFD) is a kind of graphic method to describe information flow and information change process; it can describe various functions that linked together through the flow of the data flow conveniently. Data dictionary defines the data in the data flow diagram, and it has the compensatory function to data flow diagram, and can provide the basis for the definition of entities, relationships and attributes.

Fig.3 shows the data flow diagram of the zeroth layer of purchase management system, which is realized by using Case Studio software. Fig. 3 embodies the general data flow of the purchase management module. We can see the main system roles, functions and relationships between the different functions from Fig. 3. Every handling process has a detailed decomposing data flow diagram, of which the order management process is shown in Fig. 4.

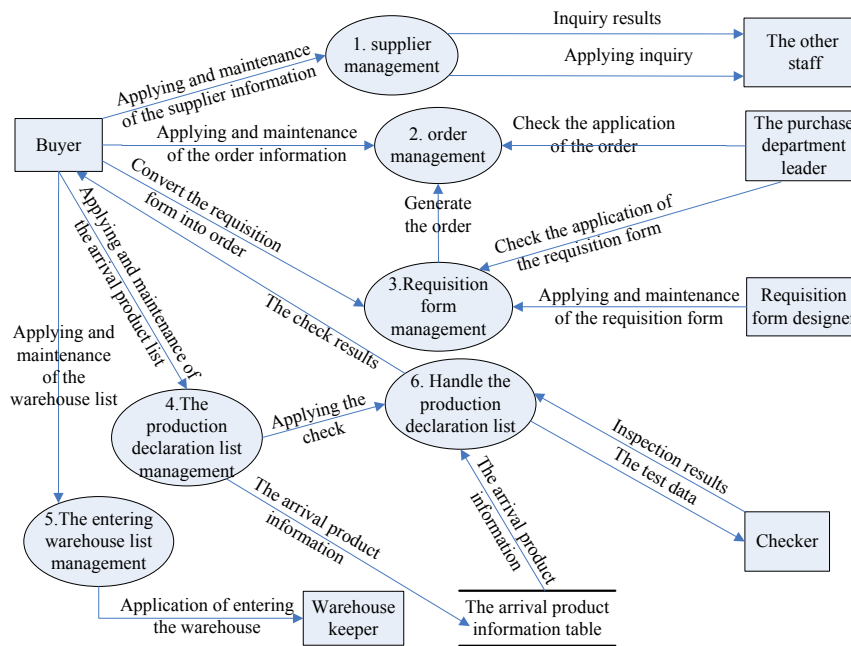


Figure 3. The data flow diagram of the zeroth layer of purchase management system

3.2 Entity Relationship Diagram Design

Entity Relationship Model(ERM) is a database design technique from the parts to the whole. Through marking the important data (which is entities) and the relationship between data, the ERM is established, then adding detailed information, such as the attributes of the entities and relationships and restrictions of entities, relationships and attributes (Tao Hongcai, 2007).

The design steps of logical database are as follows (Cui Wei, 2003):

- 1) Checking the requirements and data dictionary, defining entities, relationships and related properties, dividing the design into simple and manageable tasks. The output of this step is a partial logical model.
- 2) The partial logical model is transformed into a set of tables. Through the standardization technology enables the logical model normative.
- 3) Integrating local and logical data model to produce a global logical data model. Only when the global model ensures the proper structure and supports necessary affair, it is valid.

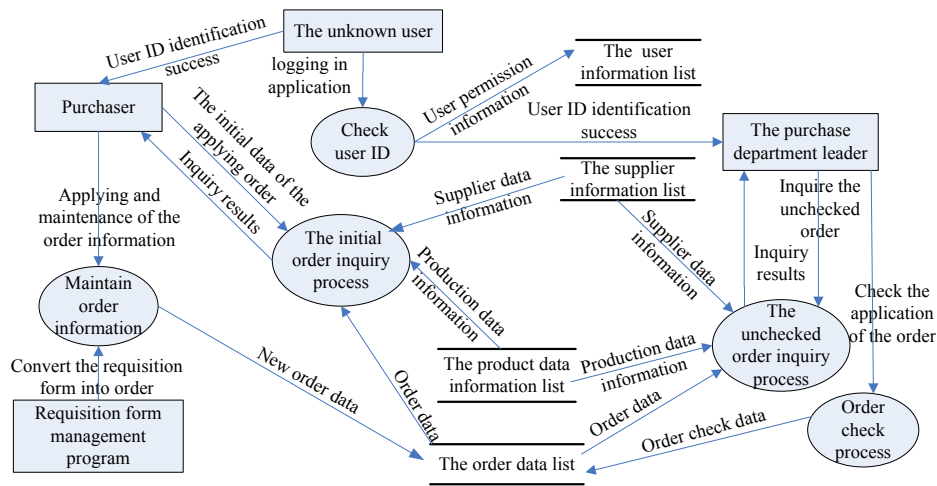


Figure 4. Data flow diagram of the order management process

The design of physical database includes using target DBMS features available to complete the design of basic table and the integrity constraints; selecting the file organization mode and the index of basic tables; designing security measures to prevent unauthorized access to data.

The design of logical data is using Power Designer software, the software can use graph mode to draw entities and relationships (ERD diagram) on this panel, it can also set the physical attributes, primary keys, candidate keys, remark, and the relationship attributes, constraints and other information, which can directly reduce the database documentation and SQL sentence (Bai Shangwang and Dang Weichao, 2004).

ER diagram of purchase order, purchasing application form and purchasing plan is shown in Fig. 5. ER diagram of production declaration list is described in Fig. 6.

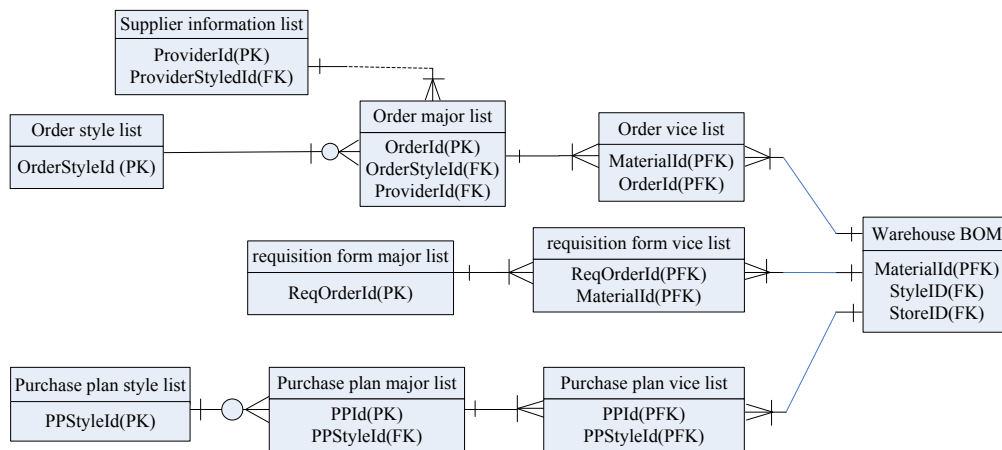


Figure 5. ER diagram of purchase order, purchasing application form and purchasing plan

4. DESIGN AND IMPLEMENTATION OF PURCHASE MANAGEMENT SYSTEMS

The purchase management system of medium and small manufacture enterprises is divided into six sub-systems: supplier information management, purchase plan management, purchase requisition management, purchase order management, production declaration list and warehouse material issue note. Among them, warehouse material issue management is divided into the consigned processing release sheet, returned cargo release sheet, release sheet modification, release sheet check, the high-level leader's check of release sheet, inquiry of release sheet and so on. In addition, the system also provides material supply information query function.

The main window of purchase order management is shown in Fig. 7. The unchecked purchase order, checked but unfinished purchase order and the finished purchase order are managed separately. Add, delete, modify and check

operations to the unchecked purchase order can be performed. Giving up check operation, converting to inspection list operation and finishing operation to the checked but unfinished purchase order are supported by this system. Giving up check operation is effective only to the order not converting to inspection list. Finished order means the order is all arrived and converting to production inspection list, while finishing operation means that the cargo is partly arrived, while the other parts cannot arrive or the order is cancelled.

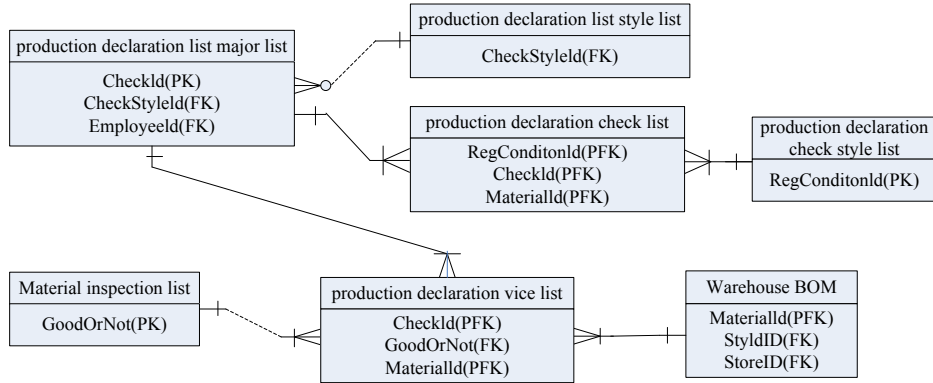


Figure 6. ER diagram of production declaration list

An order can convert into different production inspection lists according to different cargo arrival situation (but the arrival cargo quantity can not exceed the ordered quantity), so as to realize the function of split delivery. Order statistical query interface is shown in Fig. 8, which can realize effective query of date, suppliers, whether the order is finished and materials information, etc. Management of purchase requisition, purchasing plan and release sheet is similar with the management of purchase order.

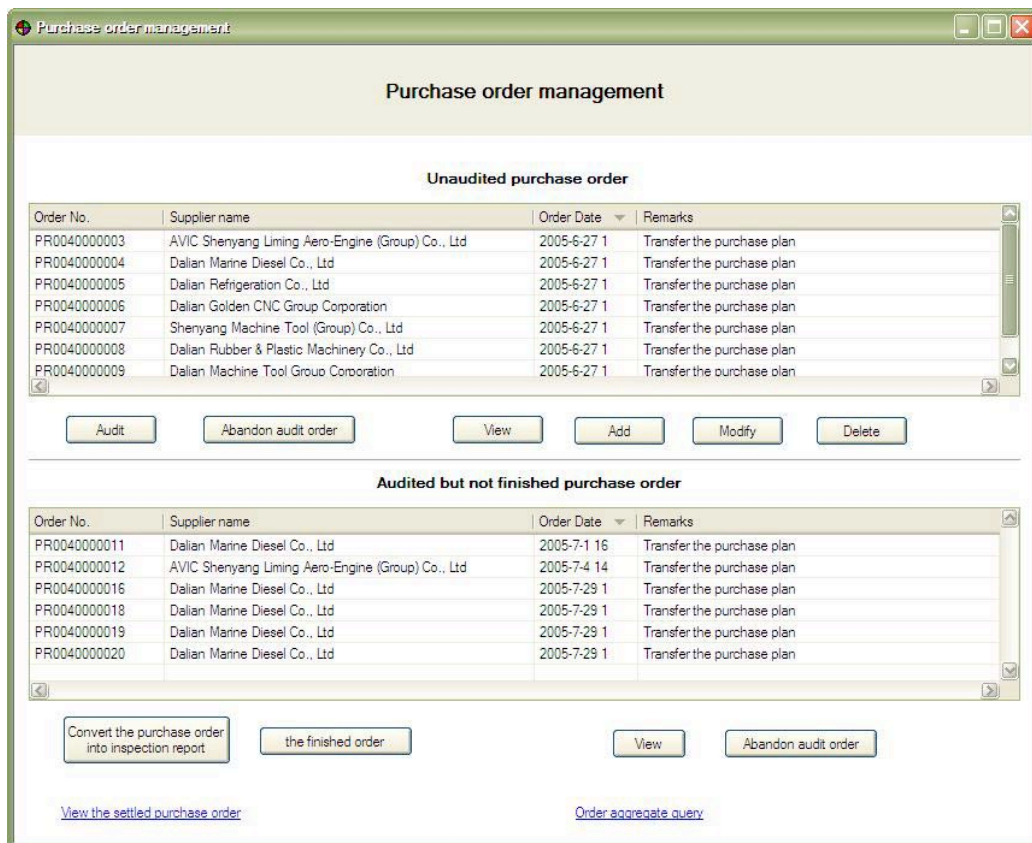


Figure 7. Purchase order management interface

Order No.	Order type	Su...	Supplier name	Order Date	Relevant bill ...	Is/isn't finished
PR004000001	Transfer the purchase plan	P008	Dalian Rubber & Plastic Machinery Co., Ltd	2005-5-25 1	PR003000000	<input checked="" type="checkbox"/>
PR004000011	Purchase requisition order	P004	Dalian Marine Diesel Co., Ltd	2005-7-1 16	PR003000000	<input type="checkbox"/>
PR004000012	Purchase requisition order	P001	AVIC Shenyang Liming Aero-Engine (Group) Co...	2005-7-4 14	PR005000000	<input type="checkbox"/>
PR004000013	Purchase requisition order	P010	Shenyang Machine Tool (Group) Co., Ltd	2005-7-4 14	PR005000000	<input checked="" type="checkbox"/>
PR004000014	Purchase requisition order	P009	Dalian Refrigeration Co., Ltd	2005-7-4 14	PR005000000	<input checked="" type="checkbox"/>
PR004000015	Purchase requisition order	P022	Dalian Golden CNC Group Corporation	2005-7-4 14	PR005000000	<input type="checkbox"/>
PR004000016	Occasional order	P013	Dalian Machine Tool Group Corporation	2005-7-29 1		<input type="checkbox"/>

Figure 8. Order statistical inquiry interface

Production declaration form management is divided into incomplete inspection declaration list, unauthenticated concession accept applying list, inspected but not processed production declaration list and concession accept applying list, finished list four parts. Buyers can change the unqualified material in inspection declaration list into concession accept applying list, after being inspected by concerned departments, the materials can be put into warehouse. Then, the finished inspection declaration list or concession acceptance applying list can be converted into warehouse warrant.

Design BOM embodies the hierarchical relationship among the product, assembly, parts and the blank, as shown in Fig. 9. It can realize the query of certain material's the position and level in the product. The design can be achieved depended on the storage of the database. Recursive query will slow the query speed, so the purchasing BOM is designed in this paper, the material relationships involving purchasing in design BOM is extracted from design BOM and stored into purchasing BOM (Jia Zhenyuan et al., 2005). Layer management using in MRP expanding is stored in a table, and extracts data from the table when the purchase plan is generating, while do not use recursive inquiry, thus the convert speed is speeded up.

The process to the monthly purchase plan and additional purchase plan is same. Firstly, the system selects the planned month, and then selects that month's unchanged production output plan; finally, the production output plan is expand into purchase plan by purchasing BOM, as shown in Fig. 10. The expanded purchase plan can be modified before being checked, and can be converted into purchase order after being checked.

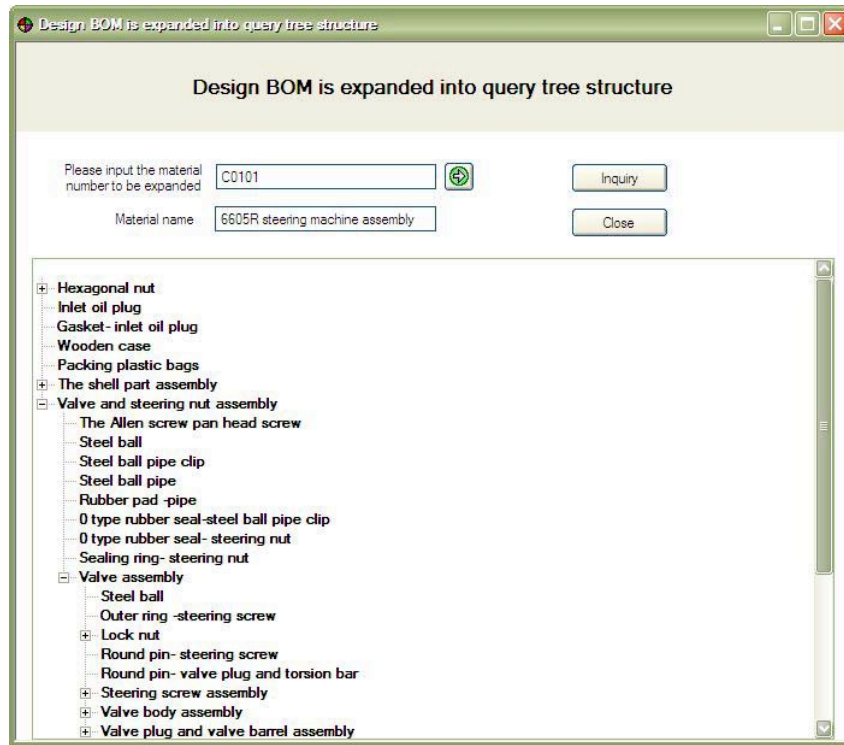


Figure 9. Design BOM is expanded into query tree structure

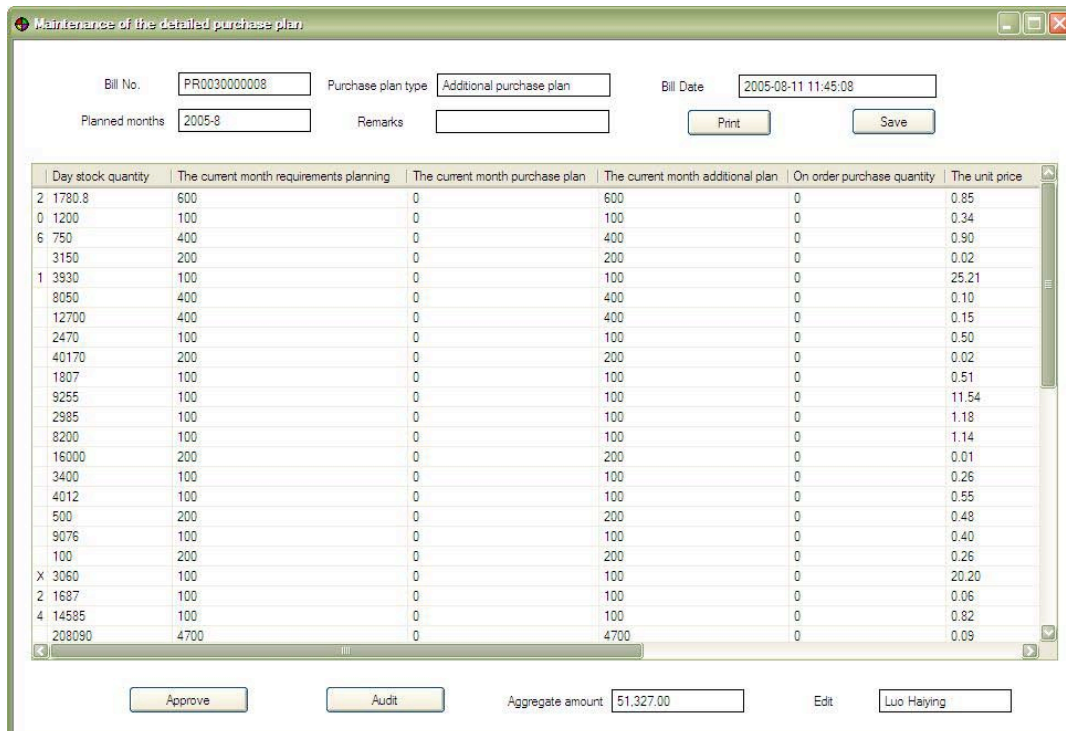


Figure 10. Maintenance of the detailed purchase plan

5. CONCLUSION

Based on the current status analyses of product structure, enterprise condition and information management situation of Chinese medium and small manufacture enterprises, this paper made reformation to the purchase management process, abandoned oral agreement and the purchase model that the arrival goods is the ordered goods, emphasized the purchase management system with the core of order, ensured the purchasing task is carried out purposely and under a good plan. A series of procedures such as applying purchase, order, delivery inspection declaration, qualified and entering the warehouse, etc. The purchase process is standardized. In addition, through the expansion of design BOM, the purchasing BOM is achieved, and the basic function of MRP is realized, which leads to the increase efficiency and accuracy of the designed purchase plan. The designed purchase management system achieved good results in the practical application, and it is proved that the designed purchase management system satisfies the need of Chinese medium and small manufacture enterprises.

ACKNOWLEDGMENT

The author would like to thank all the members of the Lean Production Project team for their help in contributing to the completeness of this paper. The research is supported by the National High-Tech. R&D Program for CIMS, China under project number 2003AA414022. The financial contribution is gratefully acknowledged.

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BIOGRAPHICAL SKETCH



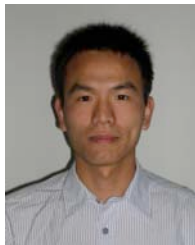
JIA Zhenyuan, born in 1963, is currently working as a professor of Key Laboratory for Precision and Non-traditional Machining Technology of the Ministry of Education in Dalian University of Technology. He received his PhD degree in mechanical engineering from Dalian University of Technology, Dalian, in 1990. His research interests are numerical control technique, rapid prototyping, and applications of smart material in sensor, actuator, and micro-robot.



LU Xiaohong, is a post-doctor in the Key Laboratory for Precision and Nontraditional Machining Technology of the Ministry of Education, Dalian University of Technology, Dalian. She received his BS degree in mechanical design and automation from Jinlin University, Changchun, in 2000. Her research interests are focused on sensors and actuators, network based manufacturing, numerical control technique.



JIA Defeng, born in 1985, is a master in the Key Laboratory for Precision and Nontraditional Machining Technology of the Ministry of Education, Dalian University of Technology, Dalian. He received his BE degree in mechanical design and automation from Henan University of Technology, Zhengzhou, in 2008. His research interests are vertical micro CNC milling machine, structure design



LV Yuanzhe, is a master in the Key Laboratory for Precision and Nontraditional Machining Technology of the Ministry of Education, Dalian University of Technology, Dalian. He received his BS degree in mechanical design and automation from Harbin Institute of technology, Harbin, in 2008. His research interests are focused on numerical control technique.

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