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# Research on Improvement of Structure Optimization of Cross-type BOM and Related Traversal Algorithm

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**Abstract.** Based on an analysis of the advantages and disadvantages of single-layer and multi-layer BOM structure, and combine with specific examples of products, a more practical—cross-type BOM structure method is presented. Aiming to solve the system efficiency problems brought by the BOM operation in manufacturing. Regarding the queue as a temporary table, this paper puts forward an improved multi-layer BOM traversal algorithm, makes full use of the basic operation characteristics and setting marks in related fields queue and simplifies the complexity of the algorithm. Compared with the traditional recursive algorithm and hierarchical algorithm, the improved algorithm has the advantages of fast speed, low resource consumption, and high practicability. And the improved algorithm is verified through an example.

**Keywords:** Cross-type BOM, Improved algorithm, Performance Analysis

## 1 Introduction

Bill of material (Bill of Material, BOM) is the core basic data in manufacturing information system[1]. It plays an important role in product design, manufacturing, sales and after sale service and it reflects the information and sharing in enterprise data integration[2]. Although the structure of SBOM and MBOM are widely used due to the advantages of recursive procedure is clear, easy to read the program and easy to maintain. BOM involves a large variety of materials, large quantity, which make the decomposition and inverse checking of products very difficult[3]. Simple SBOM and MBOM structure is very difficult to meet the actual needs.

We consider the disadvantages of the SBOM structure increases the difficulty of ensuring the accuracy and with low efficiency and the disadvantages of MBOM with the big redundancy of the data items and reduplicate definition of component structure and is unable to display the tree structure of products clearly. We present the cross-type BOM structure which can define the product structure clearly and improve the system arithmetic speed and also with superior performance in all respects. Based on this, through the studies of recursive algorithm and the algorithm of hierarchical traversal and improved the previous traversal strategy, the paper gets a optimization algorithm which with a high running efficiency, finally contrasts the arithmetic speed

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between the traditional algorithm and improved algorithm through a specific instance, then verify and analyze the algorithm.

## 2 The optimization of cross-type BOM structure

Considering the disadvantages of single-BOM and multi-BOM and the problems of various BOM structure running at the same time, this paper integrates two BOM construction methods, then presents a method of constructing cross-type BOM, in order to solve the conflicting issues of the system during the actual operation data maintenance and operational efficiency. The adoption of this cross-type BOM structure can not only improve the system efficiency but also define the product structure clearly.

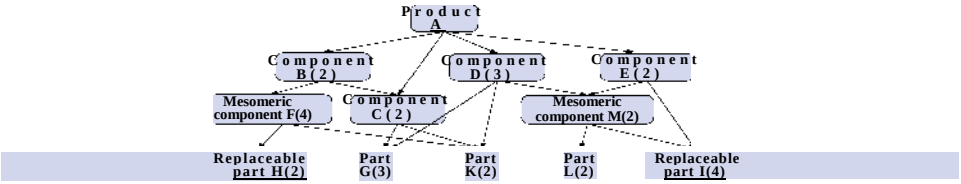


**Fig. 1.**The structure of cross-style BOM

In the actual production, the products are often more complex, parts perplexing, often need to use each other. Therefore, the single-BOM and multi-BOM are all difficult to fully represent the information of product structure, especially the complex products show the cross status. For example, the composition of product A structure in Figure 1 is more complex, it is difficult to express by a common single BOM or multi-BOM. However, a cross-type BOM can display it very clearly, which is represented in Figure 1.

## 3 The improvements of traversal strategy

### 3.1 The storage strategy of improved algorithm

In this algorithm, the queue is used as a temporary table.It is a first-in-first-out linear table, inserted in the end of the table, deleted in the head of the table. The queue operation is shown in Fig.2 for the tree structure of the BOM in Fig.1. An empty queue queue is initialized, front is the head pointer, and rear is the tail pointer, first put A into the team, meanwhile, according to the record information of A to find B, C, D, E, which are the components of A, put B, C, D, E into the queue. Hierarchical number of A plus 1. And output the related information of A. A is out, the queue is not empty, then the sub member F, C of B enter into the queue. After B is out, check the component H, K of F. Circulating like this until the queue is empty, and this

 

traversal ends. During the algorithm runs sequentially dequeue sequence is A B C D E F C G K K M G M I H K L I. According to the description of the algorithm, the process of the algorithm is shown in Fig.3.

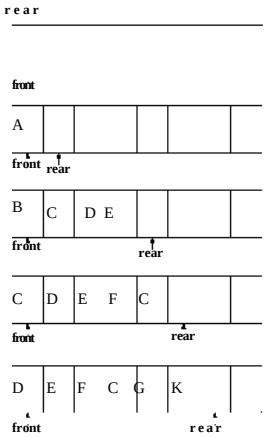


**Fig.2.** Order storage and operation of queue

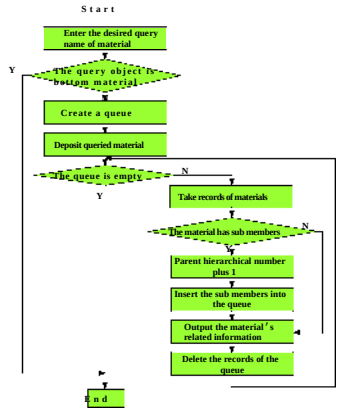


**Fig. 3.** Flow chart of improved algorithm

### 3.2 The performance analysis of algorithm

The running speed is improved obviously in the aspect of time complexity. In order to analysis product structure conveniently, assume that the product structure tree is similar to full binary tree, r is defined the quantity of tree forks, k is the depth of tree. So by unwrapping recursive algorithm of BOM, we can gain the recurrence formula: $T(1)=1, T(k)=r\cdot T(k-1)+1$. Then after it is extended and calculated, the formula changes into $T(k)=(r^k-1)/(r-1)$. By the above formula, we can make two conclusions: ①Time complexity is $T(k)=O(rk)$, it shows an exponential growth tendency with the increase of the tree's depth. ②In actual application, the quantity of r is not equal in itself material decomposition, the product structure tree is not ideally full-r forks tree. So must be cautious to choose the suitable quantity of material branches r and control the whole product tree's depth k. What's more, the opening up of memory stack needs the operation system to distribute time, but this work is transparent to user. In actually, stack size is closely related to tree's depth k.

## 4 Instance verification

We contrast the application effect of traditional algorithm and improved algorithm through the instance. The operating environment of the ERP system of a car manufacturer is WIN2000 operating system, and database uses the MS SQL Server2000, the algorithm application modules is BOM sequential check, inverse check and the calculation of preventing the nested error and the low-level. In the

aspect of operating time and the amount of processing data, the comparison of traditional algorithm and improved algorithm is shown in Figure 4 .The computer with different configuration will get different data.

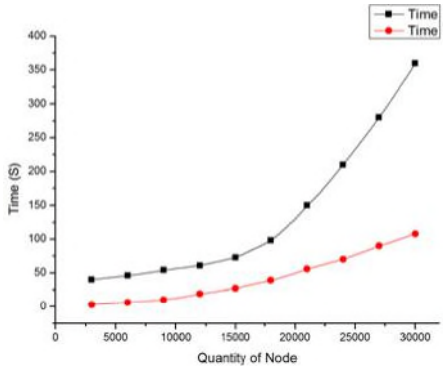


**Fig.4.** The comparison of traditional algorithm and improved algorithm

## 5 Conclusions

Through analyze and compare the structure characteristic of MBOM and SBOM, we present a method of constructing cross-type BOM, overcomes the disadvantages of the large data redundancy of MBOM, unclear product structure definition and low decomposition efficiency of SBOM. Therefore, cross-type BOM is a practical BOM constructing method. Based on analyzing the data structure of product, this algorithm not only like recursive algorithm can show the parent-child relationship, quantitative relations between the material and the whole structure of BOM tree to check nested error operation of material structure conveniently, but also like hierarchical traversal can find out all the child of the node in once search process, greatly improves the searching speed; and can overcome the contradictions of storage space size of the two algorithms can not be confirmed.

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