Design and development of turbine blade classification management system based on PDM

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Abstract. According to the requirements of modern enterprises for the classifying and managing system of product information, the structure of the flexible classifying and managing system based on internal and external codes is put forward, the function and effect of every part are particularized, which was applied in the implementation of the PDM of turbine blade. It is shown from the application that classifying and managing system can promote the development of information in the enterprise.

1. Introduction
With the rapid development of product data management (PDM) and the increasing information of turbine blades, the requirements of classification management system are higher and higher. The specific requirements are as follows: to realize the classification and coding of enterprise information; to provide the management of system authority; to provide the detailed query function of various classification information; to combine each module with each other, and to provide the required information for each department of the enterprise, rather than all the information. Facing the above problems, the author designed and developed a flexible classification management system after doing a lot of research work. This system fully considers the actual situation and the actual requirements of domestic enterprises, adopts advanced internal and external code ideas, and refers to a variety of classification and coding systems at home and abroad, and relies on the support of attribute information to realize the management and query of specific parts. The functional design and architecture of the system are completed[1-3].

2. Module division of flexible classification management system
According to the requirements of different departments, the flexible classification management system provides a set of flexible classification management scheme to meet the needs of various departments of the enterprise. The coding of parts is divided into two categories: part identification code and part feature code, that is, external code and internal code in flexible classification management system. Among them, the identification code of parts, namely external code, is used to uniquely identify the identity of parts, which runs through the whole life cycle of components and uniquely identifies parts; the feature code of parts, namely internal code [4], identifies the structure and process information of parts, which provides a detailed description for the use of internal personnel, especially the design and manufacturing departments. According to the requirements of each part, the system is divided into three parts: coding module, classification management module, system maintenance and management module. Its function and module division are shown in Figure 1.
The whole flexible classification management system is developed with PowerBuilder 8.0 and SQL server as its underlying database, which realizes the functions of classification coding, management, query and maintenance of product parts, and provides a stable enterprise information management platform. The specific functions of each module are introduced as follows.

![Figure 1. The architecture of internal and external codes.](image)

### 3. The specific functions of each module

#### 3.1 Function of coding module

For any classification and coding system, the customization of coding rules is the key of the system and the starting point of the whole system [5]. Flexible classification management system provides enterprises with the function of self defining code value and code point according to the requirements of enterprises. After the definition of code point at each level is completed, the system automatically generates matrix for subsequent code generation. Therefore, this classification management system is widely used, it can be applied to different types of enterprises.

In the process of coding rule definition in the flexible classification management system, the code values and rules of the first bit are defined first, and the code values and rules of the second code...
segment are defined according to the different code values of the first bit, and so on. Finally, the definition of coding rules is realized, and the enterprise coding rule matrix is generated, which provides the basis for the subsequent coding generation. The code generation window is shown in Figure 2.

3.2 Function of classification module

The classification module of flexible classification management system mainly includes five parts: the establishment of classification tree structure, the definition of value list, the definition of attribute, the definition of class and browsing and query. The five parts together realize the definition of the specific information of the enterprise parts products, the establishment of the classification level and the inquiry and browsing of the enterprise parts.

3.2.1 Establishment of classification tree structure. In the classification management module, the flexible classification management system provides users with two ways to establish the classification structure tree. First of all, the system can automatically generate the corresponding structure tree according to the first three digits of the part code, i.e. large class identification code and name category code. Secondly, users can manually establish the corresponding classification structure[6].

If you need to generate the structure tree automatically, you can directly select the button of automatic generation structure tree in the interface. The system will automatically establish the membership relationship according to the specific code values of the first three digits, and finally generate the specific classification tree. However, this method is only for the parts family with fewer parts. If there are many parts in the system, further classification is needed. Users can create each classification layer manually, and then add specific other classification layer structure to facilitate the further query and browsing of parts.

3.2.2 Definition of value list. In order to simplify the input work of fixed attribute value in parts, flexible classification management system provides the function of creating drop-down menu for users. The creation of drop-down menu is completed through the definition of value list. It is a kind of attribute format, which provides a convenient way for fixed attribute value.

In the flexible classification management system, the definition of value list fully reflects the system's emphasis on simplifying operation and providing convenient and automatic operation for enterprise users. It is not available in other classification and coding systems, which fully reflects the importance of flexible classification management system for enterprise parts management.

3.2.3 Definition of attributes. Attributes are the basis for distinguishing components from each other. It is one of the important ways for flexible classification management system to manage and query parts. In the classification management system, it is necessary to customize the query basis of the parts applied in the enterprise, that is to create the attribute dictionary needed by the enterprise.

3.2.4 Definition of class. In the process of flexible classification management, it is very important to define the category of specific parts. It customizes the query methods and basis of specific parts, such as name, access rights, images, views, attributes, which provides powerful support and intuitive viewing function for parts query and browsing.

a) Access rights: it defines the specific access control of each class at the class level. According to the rules of specific groups or personnel of the system, it defines their specific permissions such as view, delete, copy and save, which provides a powerful tool for the security of system components.

b) Add images and views: images can provide users with a more intuitive viewing function at the class level, which facilitates the specific understanding of this class for system users. For example, if a two-dimensional image is added to the bolt class to represent the diameter and other specific information, and the diameter D is defined in the attribute information of the bolt class, then an
association relationship can be defined between the image and the class, which provides convenience for users to understand the class.

c) Add: the view controls the user's access to specific attribute information, which includes user view, group view and default view. Views are access rights defined at the level of specific properties of a class. Take a purchased part as an example. For specific manufacturer information, the system only wants the purchasing department to see it. Then define a group view and set the display manufacturer attribute, then the purchasing department can view the specific manufacturer information, define a default view, and set no display of manufacturer attribute, then other personnel can't view the manufacturer information. The view provides different people and groups with access to different attribute information of the same class, which makes the control of system authority more flexible and powerful.

d) Add attributes: in the flexible classification and coding system, attributes are the basis of part query. For any class, corresponding attributes should be defined to distinguish or query similar parts. Attribute is a detailed description of various features of a part. In the part query system, users can input the corresponding attribute values according to the specific attributes defined by the administrator.

3.2.5 Browse and query. For any classification and coding system, the definition of rules, the establishment of classification structure and the addition of attributes are all services for the final browsing and query. Flexible classification management system is no exception. The important function of the final system is to query and browse the parts, so as to reduce the repeated operation of the design process, and provide convenience for the final implementation of PDM and other information systems.

(1) Through the operation of the definition of class, the establishment of attributes and the addition of images in the classification management system, the system users can expand the classification tree structure and view the corresponding parts, so as to have an intuitive concept and understanding of the enterprise's products and product classification.

(2) In the flexible classification and coding system, there are many ways to query parts. When the system needs to query the specific parts, it can query which class the component belongs to according to the ID and name of the class and the ID and name of the attribute. Then, according to the specific attribute conditions, enter the query criteria of the attribute, so as to query the parts that meet the needs. The parts query system will display the number of components that meet the conditions and the current position of the components at the bottom of the window. In the list window, the system lists the entries of all components that meet the query criteria. In the image window, the system displays the image of specific components.

For example, to query a steel pipe with a diameter of 50mm and a length of 1.0m, the user first queries the blade of the steel pipe according to the ID or name of the blade. Then, input 50mm in diameter attribute and 1.0m in length attribute of blade, and click search button, the system will display the qualified steel pipes, and the list window will display the steel pipes meeting the query conditions in the form of table.

3.3 Function of maintenance and management module
The system maintenance and management module of flexible classification management system can effectively maintain the whole system personnel and organization, define the corresponding access rights for enterprise personnel, and manage the recycling of waste codes to ensure the normal operation of the whole system.

3.3.1 Definition of users, roles and groups.
The management of personnel in an enterprise is an important embodiment of whether the enterprise management mechanism is good or not. The system maintenance and management module of flexible classification management system realizes the management of enterprise personnel through role
management, personnel management and group management. Through the definition of specific authority, the personnel management based on enterprise information is realized.

In the classification management system, not only the way of authority management and definition is provided for personnel, groups and roles, but also the definition of permissions at the level of class, so that enterprise personnel can manage the maintenance and browsing of specific enterprise information, and protect the information resources of enterprises.

In the coding module, the authority is divided into eight types: coding, modifying, proofreading, auditing, rule maintenance, query, user management and recycling. These eight permissions represent different operating licenses. In the classification module, permissions are divided into six basic permissions: view, delete, copy, save, cut and edit. The system administrator can give the corresponding permissions according to the defined roles, personnel and groups. The priority of permission is user > role > group.

3.3.2 Recycling of waste code.
In the process of coding, some waste codes will be produced, which is inevitable for each classification and coding module. If these codes are not cleared or recycled in time, they will occupy the code bit resources and increase the burden of the database. The system can recycle or clear these useless codes, but the elimination process is strictly controlled to prevent wrong operation. In the coding process, for ordinary coders, if they find useless codes, they can mark the deletion of these codes, instead of deleting them. The system administrator can determine whether the code is a waste code and whether it needs to be deleted according to the identification made by the coding personnel. If the code cannot be deleted, he can restore the code marked with deletion. Even if the code is deleted, the system administrator needs to confirm twice to completely delete a code. This kind of operation can avoid the occurrence of erasure coding caused by misoperation and ensure the stability of coding.

4. Conclusion
Each module of the flexible classification management system is combined with each other to meet the requirements of PDM system for turbine blade classification management system. It provides a module of self-defined coding rules, which can be defined by enterprise personnel according to the actual situation, which reflects the flexibility of the system. Automatic code generation: the user can select the specific part category according to the coding rules according to the prompt, and the system will automatically execute and generate the specific code. The two modules of classification and coding are independent, providing two classification methods: manual classification of enterprise information and automatic classification based on coding. The function of attribute definition is provided. Users can query parts and other information according to attribute information, which meets the requirements of enterprise for parts query function at present, and solves the weakness of query function in previous coding system. Authority management provides strong technical support for the confidentiality of enterprise information.

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