Organization Modeling of Maintenance Information Based on Event Driven

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Abstract. Organization modeling plays an important role in maintenance support information management and data mining. In this paper, the necessity of unitized modeling for maintenance support information is analyzed, and an organization modeling method of maintenance support information is presented based on event-driven. In the organization model, maintenance support information is divided into physical layer, events layer, and information layer. In addition, maintenance support information management system designed and development to improve the ability of maintenance support information management efficiency and data mining.

Introduction

Information oriented maintenance support information management (storage, organization, etc.) must be beneficial to the value of information mining [1].To fully tap the value of maintenance support information need effective information management, and the key to realize the information effective management is information organization[2]. Information organization is the basis of information management, its level determines the level of information management. For the purpose of weakening the complexity of maintenance support information and optimizing information organization modeling, the paper presents maintenance support information organization model based on event driven, in which events as the minimum unit of information organization and management. This modeling technology can improve the efficiency of maintenance support information collection and management, provide theoretical support for designing maintenance support information management system.

Unitized modeling of maintenance support information

A Unitized maintenance support information

Unitized is divided the system into several different function unit, and then these units can be pooled together as a whole to complete specified functions, to meet the requirements of problems[3]. Maintenance support information unitized modeling is all relevant maintenance support information refers to a system (entity) divided into subsystems according to certain principles, realizing the maintenance support information scattered, classification and reduction.

The purpose to import the concept of maintenance support information unitized is to weaken the complexity of maintenance support information, that is, the problem become easy to solve in information collection, management and analysis. Set up P_1, P_2 as two maintenance support information, and their complexity are $C(P_1)$, $C(P_2)$, respectively, $E(P_1)$, $E(P_2)$ are the workload of information collect and manage. Thus, if

$$C(P_1) > C(P_2)$$

So $$E(P_1) > E(P_2)$$

There is a law [3]:

$$C(P_1 + P_2) > C(P_1) + C(P_2)$$

If a class of maintenance support information consists of two elements (relatively small maintenance support information), the complexity of it will be greater than the sum of complexity considered each element separately. Then

$$E(P_1+P_2)>E(P_1)+E(P_2)$$

By extension, when a certain type of maintenance support information contain n separate elements, and the total, there will always be

$$C(P_1+P_2+\cdots+P_n)>C(P_1)+C(P_2)+\cdots+C(P_n)$$

And

$$E(P_1+P_2+\cdots+P_n)>E(P_1)+E(P_2)+\cdots+E(P_n)$$

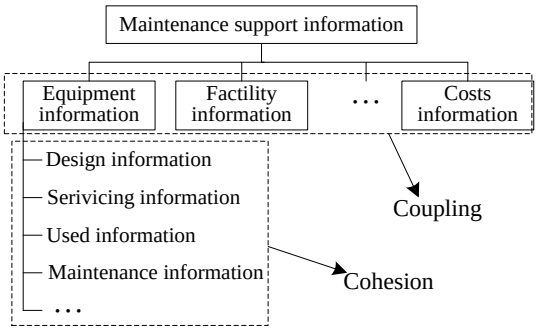
This is the basis of maintenance support information unitized modeling. This conclusion shows that decomposed complex maintenance support information into several relatively simple maintenance support information unit, its complexity is weakened, problems existing in the collection and management is relatively easy to solve.

B Independence of maintenance support information units

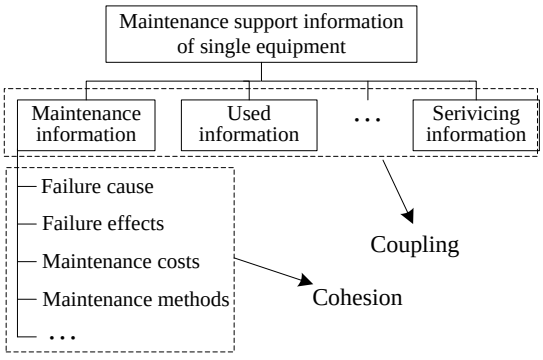
In maintenance support information organization modeling, it is aim that maintenance support information management system designed as unitary structures, which with hierarchy and each part relatively independent. Independent units are units refer to independent function and small interact with others [3].Obviously, independence is just a relative concept, because there is more or less connection between units belonging to the same system.

Coupling and cohesion are qualitative criteria in measuring maintenance support information unit independence, as shown in figure 1. Coupling is a measure of the interdependence between different maintenance support information units, cohesion is used to measure closely integrated degree of each element within maintenance support information units. The degree of coupling and cohesion directly influences the management and analysis of all kinds of maintenance support information, high coupling is not conducive to maintenance support information management, low cohesion does not favor to mining the value of maintenance support information.

In maintenance support information organization modeling, it should be as far as possible to pursuit low coupling and high cohesion between information units. Moreover, cohesion and coupling are two principles supplement each other, high cohesion within unit often means low coupling between units[3]. Therefore, it is need to choose appropriate maintenance support information unitized modeling method to improve the cohesion within maintenance support information units, reducing the coupling between information units.



(a)



(b)

Figure1 Coupling and cohesion of maintenance support information units

C Necessity of maintenance support information unitized modeling

Maintenance support information organization modeling is to describe the method of establishing relation model between different maintenance support information. The interaction relationship between maintenance support information is complex. In order to realize effective management of maintenance support information, it is need to sort out the various levels of information and straighten out the subordinate relationship between the information. Therefore, maintenance support information organization modeling must processed from all levels and overall [4].

It is mainly for business management in previous organizational maintenance support information modeling. Maintenance support information organization management proceeded on entity layer in object-oriented modeling. As the complexity of maintenance support information increasingly highlight, all relevant maintenance support information management in entity layer become complex and difficult. From the perspective of maintenance support information unitized and independence, it is necessary to further refine their and divided into several entities units.

There are many methods of division maintenance support information about an entity according to different angles, such as time sequence, physical structure, relevant events.

Due to information collection, comprehensive analysis and application are mainly at relevant maintenance support events, therefore, paper puts forward organization modeling method of maintenance support information based on event-driven in the design of maintenance support information management system. In the modeling method, different events as different information units and unitized modeling of maintenance support information entity.

Maintenance support information organization modeling method

In equipment maintenance support activities, a state of maintenance support elements occurred or changed called event. Event-driven is correlate maintenance support elements produce maintenance support information under the "stimulus" event. Maintenance support information is information sets of all events associated with the entity.

In the maintenance support information organization modeling based on the event-driven, the maintenance support information is divided into three layers: entity layer, events layer and information layer (as figure 2 shown).

Let maintenance support events $X_{m1}, X_{m2}, \cdots, X_{mn}$ related to entities Y_m, that is

$$Y_m = \{X_{m1}, X_{m2}, \cdots, X_{mn}\}$$

Related to different maintenance support events X_{mi} ($i = 1, 2, \cdots, n$), maintenance support information divide into basic information A_{mi}, configuration information B_{mi} and event information C_{mi} depending different correlation angle, namely,

$$X_{mi} = \{A_{mi}, B_{mi}, C_{mi}\}$$

All maintenance support information about entity Y_m is

$$Y_m = \{A_{m1}, B_{m1}, C_{m1}, A_{m2}, B_{m2}, C_{m2}, \cdots, A_{mn}, B_{mn}, C_{mn}\}$$

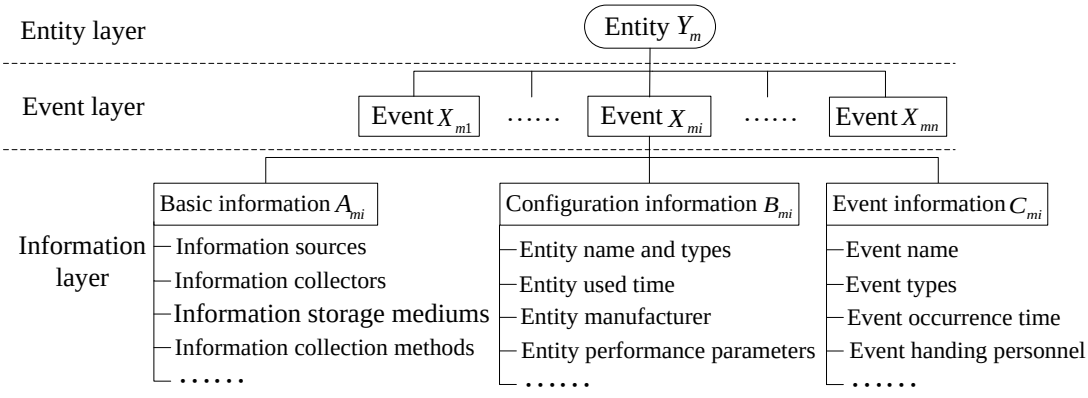


Figure2 Maintenance support information organization modeling based on event driven

A Entity layer - maintenance support information entities

Maintenance support information entities, the elements that can directly produce maintenance support information. To make maintenance support information entities with better intelligibility, maintenance support information entity built base on actual establishment system in maintenance support information management systems (as shown in figure 3). Known from consists of maintenance support information that maintenance support information entity can be spare parts, equipment, personnel, warehouse, and so on. And there is no fixed limit to the entire entity layer, the content, the quantity and the levels are scalability. When the entity is equipment, for example, it can be single equipment, can also be certain type equipment under specified establishment, or can be a group of equipment.

It can be known from the main maintenance support object of equipment maintenance support activities, that the most important maintenance support information entity is single equipment in maintenance support information management system. Single equipment maintenance support information entity can be further decomposed into parts entities, due to the entity does not belong to specific formulation, so it don't reflected in figure 3.

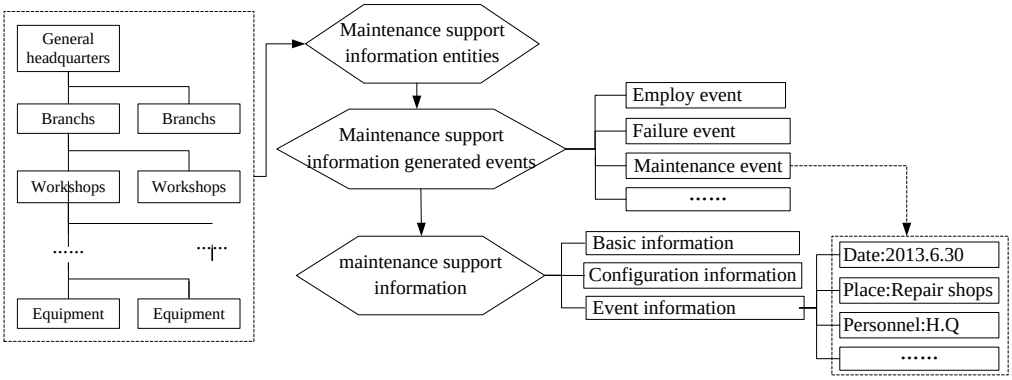


Figure3 Maintenance support information generation mechanism

B Event layer - maintenance support information generated event

Maintenance support information generated event, namely the event that can trigger maintenance support information entities generate maintenance support information. Maintenance support information entities do not always generate maintenance support information, only under the condition of specific maintenance support information event be aroused to produce relevant maintenance support information. Maintenance support information events attach to maintenance support information entities, different entities corresponding to different events. For example, when an entity is spare parts, its corresponding maintenance support information event can be employ, failure, replacement repair, original repair, maintenance, periodic overhaul, the operator monitoring, using inspection, functional test, scrap, et al.

C Information layer - maintenance support information

Maintenance support information, that is, all information related to the designated maintenance support information generated event. In maintenance support information organization modeling based on event driven, maintenance support information events as the smallest unit of information management, collection and management relevant information. For some specific events, the contents of its records include three parts:

①Basic information. Basic information primary record common basic information, such as information collectors, information sources, information storage medium, which is applicable for each kind of information entities.

②Configuration information. Configuration information main record basic features information of entities, such as entity's name, types, manufacturer, which is mainly for specific types of information entities. Configuration information is attached to entities and has a good stability for a long time, for identifying different types of entities plays a key role.

③Event information. Event information major record information closely related to a certain

events, such information mainly for the particular type events. Event information is attached to events, its variability is stronger, relevant maintenance support information would produce when a certain event occurs. Event information for describing the dynamic development process of maintenance support information entity plays an important role.

In the above three kinds of information, event information produce certain effect to configuration information, but it is not absolute, only certain events would occur some extent change to configuration information. For example, as equipment, its type, manufacturer, important structural features can be used as configuration information, after improvement repair, the important structure characteristics, manufacturers and other configuration information should be adjusted accordingly. The relationship between basic information, configuration information and event information as shown in figure 4, the figure mainly describes the configuration information of parts information entity changes due to some information.

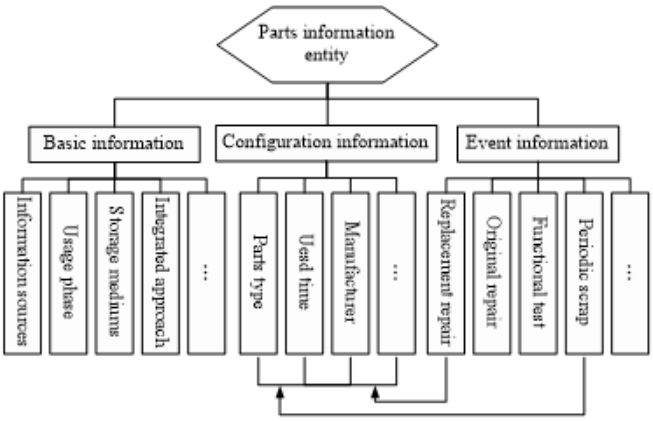


Figure4 Schematic diagram of parts information entity

Characteristics of maintenance support information organization modeling

Maintenance support information management system is designed and developed with B/S (Browser/Server) architecture[5], based on event-driven modeling method for information organization and management. Practice shows that the modeling method based on event driven shied away difficult from the description of the relationship between information. The modeling method reduces the coupling between maintenance support information events on system architecture and enhances the aggregation of maintenance support information within events, weakening the complex nature of maintenance support information to some extent. Meanwhile, it also improves the convenience of information management and enhances the openness of information management system architecture.

Figure5 Maintenance support information management system

A Convenience of information management

The theme of maintenance support information organization modeling based on event-driven is

object-oriented modeling method [6]. In terms of specific modeling, this method subdivided objective entity further on basis of objects, corresponding events divided, which attached to entity and more close to maintenance support actual. Meanwhile, maintenance support information divided into basic information, configuration information and event information in the modeling method from the relevance of related events.

Compared with traditional methods of information organization, this modeling method has the following advantages [7]: ①Advantageous to maintenance support information collection; Maintenance support information corresponding entity is much and miscellaneous, information easily to lost and with low normative if directly acquisition on entities. Information collection corresponding specific events of entity with better targeted and implementation. ② Helpful to data mining; Relatively speaking, information organization and management method based on event driven makes maintenance support information collected more concrete, abundant. Every event of entity is demonstrated, it will have a clear physical manifested when query or analysis to find the corresponding event. ③ Contribute to maintenance support activities. Various events corresponding maintenance support activities are different, this modeling method help to prepared maintenance support activity plan and scheme for different events in advance.

B Openness of information management system architecture

Maintenance support information organization based on event-driven modeling method brings great convenience for the application of maintenance support information management system. In this way of modeling under the guidance, system can expand entities, events and information at any time and achieve the function for maintenance support information template customization. That is to say, users can add, modify, and management of the corresponding information template and content according to the needs of maintenance support information comprehensive analysis and application at any time in the system. System shows great openness and helps solve the problems of information management, which causes by complex information types [8]. Maintenance support information template customization function is mainly manifested in the following three aspects:① maintenance support information entity customization; ② maintenance support information entity configuration information template customization; ③ maintenance support information entities event information template customization.

Configuration information for maintenance support information entity template customization below as an example to illustrate.

Configuration information for maintenance support information entity reflects some of the entity features relatively stable, for identifying the entity characteristics play an important indicator. Because information entities function is different, they have different configuration information, according to the different entities to set up the different configuration information template, help in the event information management. Due to information entities have different physical features, its configuration information different, too. It is contribute to information management for making different configuration information templates according to different entities.

Summary

In order to realize the purpose of efficient management for maintenance support information, article to optimize maintenance support organization modeling as a mean, puts forward maintenance support information organization modeling technology based on the event-driven. In the organization modeling, information organization modeling is divided into entity layer, events layer and information layer. Maintenance support information generated event as the smallest unit of information management. This method reduces maintenance support information complexity characteristics from organizational structure and provides theory support for developing maintenance support information management system.

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