The Research of MRO System for NC Equipment Life Cycle

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Abstract. More and more companies have shifted focus from simple product competition to the competition of ‘manufacturing plus service’ value chain at present. MRO (Maintenance, Repair, Overhaul/Operation), a general term for all kinds of manufacturing service activities, such as repair, maintenance, overhaul and operation, which is an important part of the whole life-cycle of the equipment. In order to improve the MTBF of NC equipment, we eliminate the information island maintenance services, and establish the NC equipment MRO service model for the full life-cycle oriented NC equipment maintenance system.

Keywords: NC Equipment, Whole Life Cycle, MRO, MTBF.

1. Introduction
NC equipment MRO service will be from the traditional focus on the maintenance and management of equipment in the use of stage, expand to the whole life cycle of the MRO management; At the same time of nc equipment design, manufacture, use and maintenance of information integrating storage, form the whole life cycle information management processes, can very quick query to the corresponding maintenance, repair and overhaul plan. From the perspective of the user enterprise, the numerical control equipment MRO service mainly provided by the manufacturer, allowing users reduce the maintenance management business, in the maintenance and technical personnel training and special equipment in aspects of maintenance funds also cut accordingly, so as to increase its economic benefits.

2. The Data of NC MRO System
NC machine tool is a very complex electromechanical integration products, made up of many different modules, different manufacturers of different types of machine tools, its configuration is different also. Respectively to different fault analysis module design, in according to actual needs, different modules combination, became a new machine, but there will be a lot of problems in the process of its implementation.

Every stage of the numerical control equipment MRO service requires the data support, so it is necessary for the various stage of knowledge and business data for effective organization and management, it is the whole life cycle of NC equipment MRO service of one of the core tasks. Numerical control equipment of the whole life cycle involves many phases, many levels, cross coordinated
operation between each other, therefore, in building the data model of whole life cycle of CNC equipment, should not only consider the integrity of the data and gradation, and balancing the needs of periodic and sharing ([1][2][3]). From the perspective of whole life cycle, they need on CNC equipment MRO service data can be roughly classified into three categories: MRO service stage needs to support data, service data and statistics. Support data included in the numerical control equipment common structure, the design, manufacture and assembly information, as well as the numerical control equipment operation state of relevant data, in addition to the life-cycle of the MRO service information, covers the operation manual, maintenance manuals, conventional fault handling process and scheme, etc.; Service data involved in the process of the MRO service all of the requirements, plan and implementation, from the material, the skills required to determine the service, to the scheduled plan, formulated flow card, determine the maintenance tasks in the process of service, the final decomposition to the technician to perform, this process requires a numerical control equipment, spare parts data as support, such as original data. And the final statistics is a summary of the result of the MRO service feedback, including numerical control equipment design, manufacturing, technology such as process optimization to improve data.

2.1. Support Data
Maintenance personnel in the process of the MRO service of CNC equipment, need a clear understanding of the numerical control equipment of the whole function, structure and its related functions, structure of the parts and components to the type of fault, fault position and fault, and analyzing the harmfulness of fast accurate and reliable maintenance maintenance plan formulation. The process, the basic information of the numerical control equipment and its configuration information and maintenance instructions is the basis of the maintenance personnel for MRO service support.

Product related data include: basic configuration information, user name, operating manuals and maintenance instructions, equipment state information, maintenance history and fault type, etc.; Parts related data including: spare parts stock and basic information, etc.; State of service personnel related data including: service personnel, service personnel specialty, etc.

CNC equipment MRO service stage need the support of the data structure is shown in figure 1.

![Support Data of MRO System](image)

**Fig 1. Support Data of MRO System**

2.2. Service Data
CNC equipment business in MRO service phase involves various, while doing MRO service parts due to the maintenance, the need to replace or repair the equipment itself also have upgraded resulting in the change of the type, number of component parts in the condition of the product structure is state evolution, accordingly it will increase in the original foundation database a number of services for business data. Product data including: maintenance requirements, maintenance plan implementation, maintenance, repair history record, etc.; Parts related data including: spare parts dispatch information and new orders,
etc.; Service personnel related data including: personnel dispatch information and service history record, etc.

CNC equipment MRO service stage of data structure is shown in figure 2.

![Service Data of MRO System](image)

**Fig 2. Service Data of MRO System**

2.3. **Statistics Data**
NC equipment in the process of the MRO service not only need the support of relevant data, at the end of the service leaves a lot of complex maintenance history records and maintenance solutions such as data, need to use statistical methods to vast amounts of data analysis, storage and management of maintenance, so that in the process of knowledge management can accurately obtain some valuable information, design, manufacture and maintenance of equipment of numerical control phase of the quality improved significantly.

Product data including: running time statistics, maintenance records statistics and failure mode; Parts related data including: spare parts service statistics, parts replacement information statistics, etc.; Service personnel related data including: state statistics, tasks involved in statistics and time statistics, etc.

CNC equipment MRO service phase feedback statistical data structure is shown in figure 3.

![Statistics Data of MRO System](image)

**Fig 3. Statistics Data of MRO System**

3. **The whole life cycle of NC equipment data acquisition**
NC equipment the whole life cycle of key data, variety and diverse, mostly distributed in different departments in the process of business process, to achieve effective integration using these data is the premise of how to obtain them.

Operation monitoring, is mainly refers to using intelligent sensing technology of numerical control equipment real-time continuous monitoring of running status, so as to obtain the numerical control
equipment status information and operation data. The run data is the primary basis for developing the MRO service, therefore, real-time acquisition product data is one of the important link of the MRO service operation.([4][5])

The install at the scene of the numerical control equipment acquisition unit, collect data from the workshop control system, and access to products of run-time important parameters such as temperature, pressure, velocity, size, access the Internet through a variety of network access. Transfer protocol USES OPCUA, the underlying http/https, using TCP or can pass through the firewall, to the monitoring center of the real-time data server. Data stored in an active way to upload the data server can be used, effectively reduce the communication load.

Acquisition unit is made up of various types of sensors, embedded platform or industrial computer. By the sensor sensing the change of the change of physical quantity into electric signal, through the embedded platform or industrial PC into computer can identify and storage of digital signals, the real-time data uploaded to the server. After MRO system analysis processing of the data in the data server, judge whether the product failure or fault early warning on the horizon.

This study will MRO system is divided into six modules: system management module, knowledge management module, operation management module, MRO management module, material management module and statistics module, as shown in figure 4.

![Fig.4 NC Equipment MRO System](image)

4. Conclusion
By analyzing the data of numerical control equipment, this study established the full lifecycle oriented intelligent CNC equipment maintenance, repair and support system, puts forward the full lifecycle oriented maintenance, repair and support system integration model, describes the maintenance, repair and support system and product data structure, inventory management, financial management, production management, supply/procurement management, customer/sales management, product recycling system integration module. This laid a solid foundation for the workshop of intelligent data management.

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