Intellectual Production Supervision Perform based on RFID Smart Electricity Meter

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Abstract: This topic develops the RFID intelligent electricity meter production supervision project management system. The system is designed for energy meter production supervision in the management of the project schedule, quality and cost information management requirements in RFID intelligent power, and provide quantitative information more comprehensive, timely and accurate for supervision engineer and project manager management decisions, and to provide technical information for the product manufacturing stage file. From the angle of scheme analysis, design, implementation and test, the system development of production supervision project management system for RFID smart meter project is discussed. Focus on the development of the system, combined with the main business application and management mode at this stage, focuses on the energy meter to monitor progress information, quality information and cost based information on RFID intelligent power management function. The paper introduces the design scheme of the system, the overall client / server architecture, client oriented graphical user interface universal, complete the supervision of project management and interactive transaction information display, the server system of realizing the main program. The system is programmed with C# language and.NET operating environment, and the client and server platforms use Windows operating system, and the database server software uses Oracle. The overall platform supports mainstream information and standards and has good scalability.

1. Introduction

As China has put forward the concept of building a “Smart Grid”, the State Grid Corporation of China formulated a development plan of the smart grid in July 2009. The electricity consumption data acquisition system is one of the most important components of the smart grid. As the most fundamental element, intelligent electric energy meters play a decisive role in the electricity consumption data acquisition system. Therefore, the quality of intelligent electric energy meters exerts a direct influence on the stability, safety and economy of the acquisition system and the smart grid and, at the same time, on the service life period and the rotation cycle of intelligent electric energy meters.

Many foreign countries have begun to put similar systems into use. The production and manufacturing supervisions are managed by computer technologies, which achieves the dynamic monitoring of information and documents and, at the same time, improves the efficiency of the production and manufacturing supervision management and the quality of electric energy measuring equipment. Comparatively speaking, China’s production and manufacturing supervision management system of electric energy measuring equipment is still in an exploratory stage. Although many domestic cities begin to use similar systems, the production and manufacturing supervision

management system of electric energy measuring equipment has no sophisticated template at home and abroad. Therefore, it's extremely necessary to develop a suitable manufacturing supervision management system of electric energy measuring equipment in order to improve the production and manufacturing supervision management efficiency of electric energy measuring equipment and improve the high-tech management levels of enterprises.

2. The Overall Plan Design

The overall software plan of the manufacturing supervision project management system of intelligent electric energy meters based on RFID adopts the Client/Server architecture. The Client adopts a generic graphical user interface to finish interactive transactions and information display concerning the manufacturing supervision project management. The Server focuses on main system procedures, which can be divided into the progress management procedure module, the quality information management procedure module, the cost information processing procedure module and the basic information management module. The basic information management module of the manufacturing supervision project is transplanted from a previously developed tool platform and other modules are newly developed results in this phase. In addition, a database system is equipped at the basic level of the Server, which provides a uniform and comprehensive management of static and dynamic information for the implementation of the system.

Figure 1 demonstrates the architecture design plan of this system.

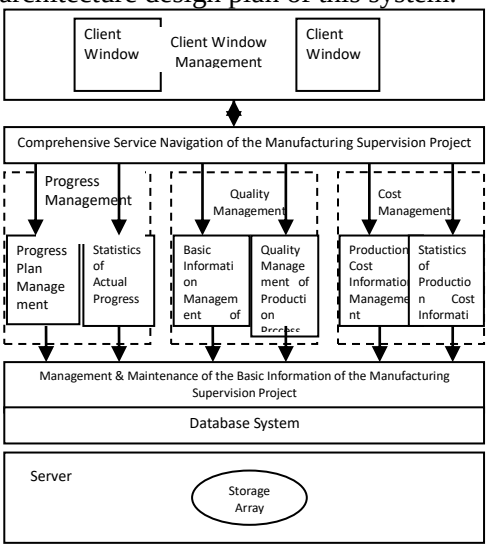

Figure 1 The Architecture of the Manufacturing Supervision Project Management System

3. The Manufacturing Supervision Module System

The procedural programming of the production and manufacturing supervision project management system for intelligent electric energy meters based on RFID adopts a C Sharp and .NET running system. The Client and the Server platforms adopt the Windows OS. The database server software adopts the Oracle. This chapter makes an introduction to the realizations of the manufacturing supervision progress management module, the manufacturing supervision quality management module and the manufacturing supervision cost management module and also gives a summary of tests on this software.

3.1 The Manufacturing Supervision Progress Management Module

The progress management procedure of the intelligent electric energy meter project based on RFID is designed according to object-oriented concepts and methods. The main objects within the procedure consist of FMSCp, FMSPIan, FMSMrp, FMSWk and FMSAdvSt, which respectively deal with the conversion of production capacity demands, the calculation of production progress plan information,

the calculation of material demands, the unit task information of works and the statistics of actual progress data concerning the manufacturing project of intelligent electric energy meters based on RFID. The manufacturing supervision progress management procedure finishes the main information processing tasks according to the following steps.

According to current intelligent electric energy meters based on RFID and corresponding scheduled completion time and assembly-number and lead-time parameters of intermediate nodes on the product structure list, this procedure preliminarily calculates the completion time of each intermediate product through a member function of fmsCrps by calling the object of FMSCp. Taking results above as an input, this paper calls the function of fmsWkdEval to calculate the expected processing time of each type of equipment according to technical procedure information that conforms to each intermediate product, including the beginning time and ending time of such expected processing. In addition, the function of fmsWkdEval calls its internal function of fmsRmLdEval to calculate the surplus load among expected intervals of each processing work time, according to actual production load currently recorded by the system. If the surplus load is higher than the expected load generated by the mentioned-above calculation, the production dispatching among such time intervals is feasible. The detailed data of the progress plan is generated by the mentioned-above calculation result via the object of FMSPIan.

After generating details of the progress plan mentioned above, this procedure calls the function of fmsMrp to calculate a corresponding progress plan of material demands. The calculation of the progress plan of material demands by the function of fmsMrp is based on product models of the current project. Corresponding product structure information and technical procedure information are determined via the basic information management module. By virtue of the function of maramet, the fmsMrp determines the material quantity, works' lead-time and processing work time on special equipment units of this node required by each unit of parent node production that is expressed by attribute parameters of each technical unit node. The function of mrpEval makes a traversal of each product structure list and internal node sequences of technical procedures in order to calculate corresponding production processes' demand information of each material specification and of unit working quantity of each technique and equipment, including material specifications, minimum demand quantity, latest ready time, equipment unit of technical works and corresponding work hours and latest completion time. All such information will generate a plan of material demand information. Based on such information, unit work and task information required by the progress plan will be generated by virtue of the function of fmsWkln.

After being implemented, this procedure firstly calls the objects mentioned above to finish the calculation of the progress plan and then calls the function of FMSAdvSt after determination. Each manufacturing supervision project conforms to one FMSAdvSt object which waits for the acceptance inspection of each work unit in the cyclical pattern. Corresponding functions are called to make conversions of accepted and inspected unit works and a comparative statistics of the progress plan calculated at the preliminary stage is made. The proportion of each current progress indicator is calculated against actual completion indicators according to the progress plan.

The flow chart of the manufacturing supervision project progress module described as Figure 2 is made on the basis of the combination of calculation results mentioned above.

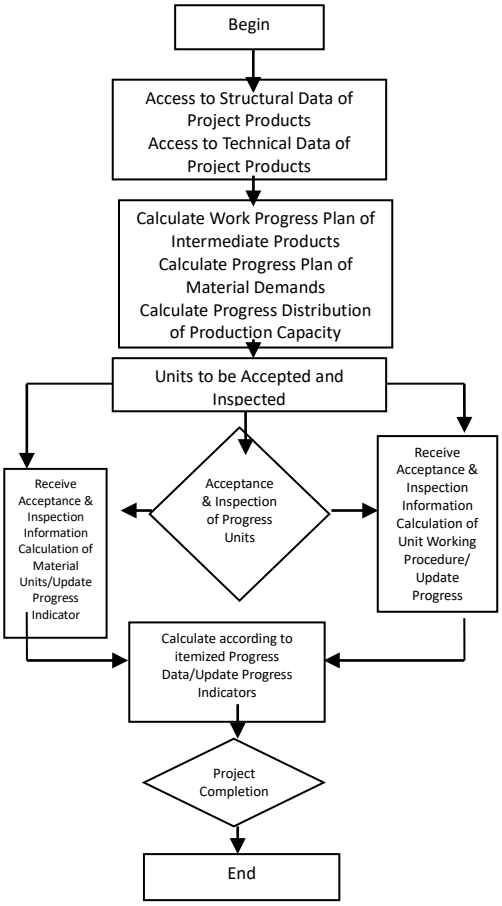

Figure 2 The Progress Management Flow Chart of the Manufacturing Supervision Project

3.2 The Manufacturing Supervision Quality Management Module

The procedure of the quality management module of the manufacturing supervision project uniformly deals with quality inspection and testing data generated during the production and manufacturing process of intelligent electric energy meters based on RFID. The procedure involves two groups of objects: product inspection and testing information management objects and product material inspection information management objects.

With different base classes, such two groups of objects internally deal with different types of quality inspection and testing data collections based on different rules and, at the same time, integrate results handled by work sequence information as an integral object, which enable each work sequence and each material batch to conform to complete quality inspection indicator information specified by the quality standard. Corresponding design plans aiming at the objects are described as follows.

The base class object of the product quality inspection and testing information management objects refers to FMSExp. The sub-class objects derived from the base class of FMSExp are as follows:

Aging Testing Data Management Object: FMSFxExp;

EMC Testing Data Management Object: FMSHPExp;

Over-voltage Testing Data Management Object: FMSShkExp；

Over-current Testing Data Management Object: FMSShkExp；

Reliability Testing Data Management Object: FMSMLExp.

According to the calculation processing requirements of the special data structure of quality inspection and testing data, different types of sub-class objects make an overload of member functions of the base class mentioned above. By regarding the ExpMLExp of the reliability testing data

management of intelligent electric energy meters based on RFID as an object, the function of ExpIdsEval makes an automatic calculation of testing and evaluation indicators in accordance with national standards and on the basis of testing condition indicators, work condition indicators and corresponding basic parameters, including the configuration information of testing product model components, overload condition indicator and corresponding values, overload process indicator parameters, super-critical process indicator parameters and actually measured data sequences.

The functions of RIdxDA and TdDa of each category of objects respectively achieve the comprehensive reliability analysis and the trend analysis on the basis of original quality inspection sample data. The comprehensive reliability analysis of testing sample data is based on the reliability model and the failure model of the driving sub-system of intelligent electric energy meters based on RFID. The access interface of the reliability analysis model & module of the system is launched. The latter internal procedures calculate current reliability indexes of each batch of inspection data according to the reliability index calculating model achieved by the national industrial standard.

The class diagrams of the objects mentioned above are demonstrated in Figure 3.

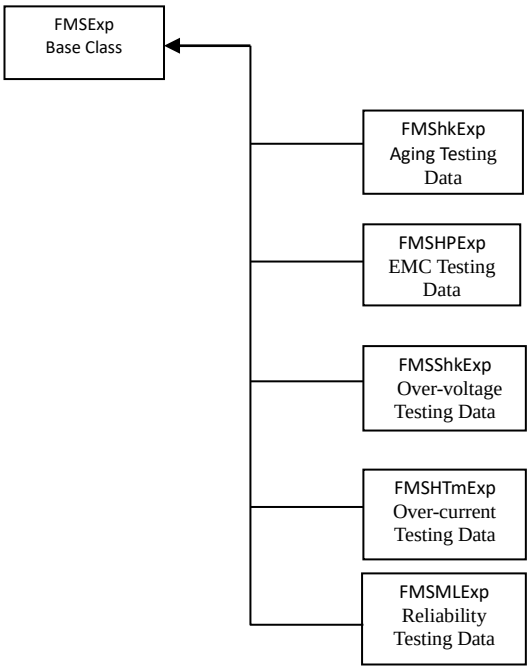

Figure 3 The Class Diagram Model of Quality Inspection Testing Information Handling Objects

This module regards the material quality inspection testing information management object as the function of FMSMtspExp. The object of FMSMtspWxp conducts an analysis calculation of the correlation between production technique & material quality inspection indicators and product quality through the function of mPSigEval. Based on the quantitative model, the basic calculation refers to the analysis of the relevant relationship between product reliability indicator & technique quality level and raw materials' quality level during specific time intervals. Based on the minimum root-mean-square error criterion, this function adopts a multi-linear regression model fitting algorithm to calculate a regression coefficient of a designated batch of products, corresponding raw materials and quality indicators of techniques. The size of the regression coefficient reflects the correlation degree between product reliability indicators and basic variables (namely quality indicators of various raw materials and techniques), or the sensitive degree of the latter against the former.

Based on objects mentioned above, the procedure of this module will call corresponding objects to deal with and calculate original experimental data collected in order to acquire testing indicator data specified by the industrial standard. Such data are stored to build a database and corresponding unit progress statistics are implemented via information announcement progress management procedures.

3.3 The Manufacturing Supervision Cost Management Module

The manufacturing supervision cost information management procedure of intelligent electric energy meters based on RFID consists of two types of objects, which respectively deal with and maintain production & manufacturing expenditure information and basic information of expenditure calculations. The object of FMscost makes an itemized and statistical calculation of production & manufacturing cost information. The interface function of the object of FMSCost makes data statistical calculations by calling a database storage procedure.

The statistical function of FMSCost for the production work expenditure: the database routine called by the function of fmcWOdx makes a summary of working tasks of all intermediate products and actually completed working task quantity during the time interval according to the established time. This database routine will generate a corresponding cost value through the multiply of working rate parameters by planned material demand quantity and actual material consumption quantity of each task that are clearly calculated according to data records during the production working process.

The statistical function of FMSCost for material details: with the categories, specifications, production working sequences or unit working tasks of production materials as the index, the database routine called by the function of fmcMtdx calculates specifications and batches of production material dispatch and the production material costs converted by the actual out-purchased price of this batch of production materials. This calculation result can also be used to calculate the direct working cost of production units.

The detailed statistical function of FMSCost for surplus materials: with the categories, specifications, production working sequences or working task records of production materials as an index, various database routines called by the function of fmcRmdx calculate material returning time and batches of corresponding surplus materials and costs converted by the actual out-purchased price of this batch of materials and adjust actual manufacturing and production work costs by subtracting such cost values.

The detailed statistical function of FMSCost for intermediate products: the function of fmcMvnt makes a record and statistics of time, quantity and average circulation period, when it comes to the internal circulation affairs of intermediate products of each project.

The object of FMSdmCost distributes statistical cost data according to progress information of product projects.

The function of FMSdmCost: the database routine called by the function of fmcDxpt makes an automatic summary and calculation of final working costs every day when production shifts end, according to actual operation records. Then, such database routine calculates the distribution value of indirect costs according to the working quantity proportion of intermediate products.

The function of FMSdmCost: the database routine called by the function of fmcMxpt conducts a similar calculation for units per month. The database routines called by the object of FMSdmCost for surplus production material cost allocations, cost transfer processing and the statistical calculation interface of production consumption calculate the surplus material model and quantity, shortage material model and quantity and the ratio of the actual material consumption quantity against the quantity required by the progress plan by virtue of basic working sequence units. The cost calculations mentioned above provide quantitative data foundations for an actual cost accounting of the integral project.

4. Conclusion

Studying a production and manufacturing supervision management system of intelligent electric energy meters based on RFID, this paper introduces its compositions and realization methods from various perspectives, including the overall plan design, the progress management module, the quality management module and the cost management module. This paper also provides a relatively integral and accurate quantitative management of the production and manufacturing supervision progress information of intelligent electric energy meters based on RFID and implements a monitoring of actual progress in every phase. The overall platform supports mainstream information and standards and

demonstrates fine extensible capabilities.

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