The Design of Manufacturing Execution System Based On RFID

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Abstract

From the supply chain, now RFID technology is gradually applied to the core of manufacturing process. By adopting the RFID technology in workshop layer, the exact real-time information that is obtained from RFID, can be seamlessly integrated into the manufacturing execution system. Therefore it can create additional value, and increase productivity for the enterprise. The technical advantages of applying RFID technology to the manufacturing execution system are analyzed detailedly by this paper. Taking the textile industry as object, the design of manufacturing execution system based on RFID is presented by this paper. And it provide perfection system solution for enterprise realizing real-time informatization.

1. Introduction

Manufacturing execution system (MES) is defined as a shop floor control system which includes either manual or automatic labor and production reporting as well as online inquiries and links to tasks that take place on the production floor. MES includes links to work orders, receipt of goods, shipping, quality control, maintenance, scheduling, and other related tasks. The MES (Manufacturing Execution System) is the connecting link in the enterprise information integration system, which is the bridge of information between the Manufacturing and management, so it is the key to the development of enterprise informationization. RFID(Radio Frequency Identification) is new automatic identification technology, which has many advantages, such as a long-distance contact, non-mechanical wear, programmable, a bigger storage and more flexible memory. RFID technology is very suitable for data acquisition and process control in the industrial manufacturing sites, because of its characteristics of waterproof, antimagnetic, high temperature resistance, etc. All of those characteristics of RFID technology can be relied on by manufacturing enterprise to obtain real-time information, which can be seamlessly integrated into the manufacturing execution system and decision of management can be transferred to the industrial manufacturing sites. The technical advantages of applying RFID technology to the manufacturing execution system are analyzed detailedly by this paper. Taking the textile industry as object, the design of manufacturing execution system based on RFID is presented by this paper. And it provides perfection system solution for enterprise realizing real-time informatization.

2. The advantage of applying RFID technology in manufacturing execution system

Applying RFID technology to the manufacturing process, the real-time production data can be written into RFID tags, such as process data, raw material data, quality data, etc. Therefore, enterprise can master real-time workshop production data, such as Production Schedule, raw material quantity in-process, work-in-process storage. Through real-time information mining analysis, enterprise can realize lean production at the workshop floor. Those dynamic manufacturing information is integrated to the enterprise management system, what make management can dynamic analyze production plan implementation, respond quickly to the changing of the market, and adjust the plan of production and purchase. The production quality can be managed dynamic, provide basic information for production quality traceability.

Because of applying RFID technology in those notes of production, enterprise can obtain the real-time information of manufacturing process to improve the production efficiency and reduce the production cost, perfect production management. At the same time, the real-time information can be transferred to upstream and downstream enterprises. The more real-time information is shared by enterprises, the more utilization values of real-time information are improved. Just a lot of RFID technologies are used, therefore the enterprise management is more intelligent and automation.

3. System design

3.1. The analysis of application background
The example of a certain textile enterprise manufacturing execution system is given by this paper. According to the characteristic of manufacturing process, the general design scheme of manufacturing execution system based on RFID technology. Considering the manufacturing process, the textile, especially cotton spinning industry is hybrid industry system of process and discrete, and the manufacturing process of cotton yarn is closer to process industry. The production process of cotton spinning industry is shown in figure 1. The process cleaning-cotton and carding can be incorporated into blowing-carding, because the equipments are different. The times of drawing is determined by production process. It is also the case with doubling and twisting. There are many kinds of equipment at one process. Therefore, the process should be determined by not only production variety but also production situation.

Considering the production process, the cotton spinning industry is semi-continuous process industry and it can be taken for continuous process industry as a whole. It is different between the cotton spinning industry and general process industry that there are different types of equipments at same process. Its characteristics are as follows:

1. Multi-equipment serial;
2. Multi-equipment parallel;
3. Some productions have the characteristics of reverse process and skip process;
4. Multiple specifications simultaneous on production line;
5. Many production constraints (equipment productivity, exchange time, production process);
6. Production process complex.

3.2. The general architecture of system

According to the analysis of enterprise status, there is many problems in the enterprises management, such as data resources wasting, data transmission inaccuracy and not in time. To counter these problems, manufacturing execution system is divided into three floors, which are production control floor, process monitoring floor, field control floor. In the field control floor, the PROFIBUS field bus is adopted to real-time monitor electrical equipment at production field. Through using RFID technology, the key data of production process can be real-time acquired, and also work-in-process storage, worker attendance. The real-time data of production site is monitored by process monitoring floor, and scheduling optimization of production. The production is integrated into management system by production control floor, therefore enterprise management can accurately obtain operation information of production site in time. The production system can be seamlessly integrated into the management system, what make production data be sharing, and many control systems can be comprehensively analyzed and uniform planned. The general architecture of system is shown in Figure 2.

3.3. System function design
Through the feasibility analysis for enterprise status, the manufacturing execution system is divided into six subsystems. That are as follows: workshop management, equipment management, monitoring management, quality management, cotton assorting management, production plan, all of those are shown in Figure 3. The concrete function of every subsystem is as follows:

(1) Workshop Management Subsystem:
Workshop management play an important role in production management as acceptance production order, organizing production, recording production data, controlling production, providing information feedback for higher authorities, guaranteeing production stationary. The concrete modules are as follows: production team management, reporting production data, plan declaration at bottom layer.

(2) Equipment Management Subsystem:
Equipment is the important port of enterprise fixed assets, and the base of production. The usage rate and intact rate of equipments are directly related to enterprise production efficiency and organizing production condition. All of equipments should be registered, and the key equipment must be established account. The every archive content of equipment consists: technical data, maintenance content, cycle and record. It is important that special textile parts should be administered specially, such as top-roller, ring, reeds, etc.

(3) Monitoring Management Subsystem
Monitoring management subsystem bases RFID and PROFBUS. The industrial configuration software FIX is used to monitor equipment in production sites, and whole production process. The production data and work-in-process storage of important process should be acquired real-time, which have great influence on production. The consumption of water and electricity can be monitored automatically.

(4) Quality Management Subsystem
Quality management includes two ports, which are product quality management and semi product quality management. From the raw material to production, the quality at every node of production process should be tracked by using RFID technology, and at same time establishing the feedback mechanism of quality backtracking. The production quality trend chart in the important node of production can be established, therefore enterprise can visually analyze quality statistics to find out the key of quality fluctuation and improve the quality of product.

(5) Cotton Assorting Management Subsystem
Cotton assorting management subsystem applies the method of classification-queue to assort cotton. The classification is that cotton is divided into one class, which suits some tex yarn. The queue is that the different batch cotton is arranged a team, the regions, property, type of which are close. After one batch cotton has been used up, another batch cotton of same team will be used to replace it.

Cotton assorted by computer base standard technology parameters of cotton yarn, which provides optional batch number of cotton ,according to technology parameters of present cotton and the condition of classification-queue tables. After the new batch cotton has been used, the technology parameters will be recalculated, and the price information of cotton will be transferred to the quotation system

(6) Production Plan Subsystem
In fact, the enterprise will guarantee equipment under the condition of full load operation. After obtaining new production plan, the enterprise must stop some production for vacating equipments and special textile parts to meet new order. Then enterprise will calculate the gross profit of a single production and make the comprehensive resources of production reach equilibrium with new plan, what base related data, such as equipment data, work center data, process design, special textile parts information, etc. At last enterprise make optimization adjustment of present plan and append new plan into present master plan for generating new master plan. According to the new master plan and fact production condition, the enterprise can arrange production.
4. The application of RFID integrated with MES

Enterprise middleware technology is extended to RFID field by RFID middleware, which can shield the diversity and complexity of RFID equipments, and provide great support for background system. Therefore more widely RFID equipments can be applied in enterprise. The RFID middleware framework of this system is shown in figure 4.

![RFID integrated with MES](image)

The RFID data from different types of reader must receive adaptability treatment by the reader interface, and then the RFID data will be unified form. After data verification, the RFID data will be packed accordance with protocol of user defining. The packed message will be cached in message server by message management. All of these messages will be classified based on their content, and same class messages should be arranged in the same message queue. After the repeat RFID data are filtered by data filter module, the filtered data will be transferred to center database. At the same time, the data access module of data interface can provide the interface of center database for enterprise application and remote application system.

5. Conclusion

Through integrating RFID technology into present manufacturing execution system, the more great information chain can be established. The accurate information can be transferred in time, therefore the productivity can be enhanced and the utilization ratio of assets can be improved. The higher level quality control and every kinds of on-line measurement can provide information base for monitoring management of production process and optimization adjustment of production plan. Relying on RFID technology, the enterprise can implement Lean Production and differential production. Considering its production capability, the enterprise should establish reasonable production plan and auxiliary plan to meeting market change. Avoiding waste of repeat build, the enterprise should establish suitable design of system to meet itself condition. It is more important that manager and engineer should realize fundamental change in the management idea through implementing manufacturing execution system.

References


