Design of Collaborative Production Management System Based on Big Data

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Abstract. This is a study of a Production Management System framework for the execution of collaborative tasks in enterprises cells. Collaborative innovation production management system is seen as one of the key elements of Industry 4.0. In this research, the Hadoop Platform/NoSql/Oracle Stream and some other technologies are used to handle the big data collecting from the sensors. The collaborative production Management System framework is proposed and the Equipment operation and maintenance system as a demonstrate of the system is shown in the paper.

Introduction

The German put forward the "Industry 4.0"[1]. As following, the China raise "Made in China 2025" plan in 2015[2]. Nowadays how to deal with the big data between different enterprise cells is one key technology. A Collaborative Production Management System is a temporary alliance of enterprises that come together to share skills or core competencies[3]. Meanwhile in the manufacturing system, the expert systems and artificial intelligence techniques is widely used. Collaborative Production Management System lies in life-cycle manufacturing, mainly including Production Management, Resource Management, Quality Management, Decision Making System and so on.

The following reviews two aspects on the present situation of research at home and abroad:

1) The Collaborative Production Management System for the CPS

Cyber - Physical System (CPS) is one of the key system of intelligent manufacturing[4]. While the CPS is an integration of computing, communication and control technology which will be integrated the Information System and Physical System. The CPS is cutting-edge of technology of effective cognition and controlling of physical system. CPS is a new stage of the global information technology and is becoming the international hotspot. In formal modeling of CPS, researchers have made some achievements at home and abroad, divided into the following categories: CPS modeling method based on the Actor, AADL; modeling and validation method based on hybrid automata, differential dynamic logic and Petri net. They are different theoretical basis. And in general, modeling and validation work of CPS is not enough at present: The modeling is not formal; The Timed Automata Semantics, who is a mature algorithm and effective model method, cannot handle complex data and cannot describe the interaction between the CPS and physical system.

2) Big data processing technology for collaborative production management system

With the development of Internet technology, multiple sources of data are in explosive growth[5]. Huge potential application value can be obtained from the extraction, processing and analysis of the big data. Big data applications, as a new field of development, have attracted the attention of numerous scientific research personnel.

But the data fusion problem based on unstructured and semi-structured data is difficult to quantify. Current data fusion research still has the following problems[6]:

①There are big differences to expression of the same object when unstructured data and semi-structured data are used.
②Due to different information source may provide incomplete, false, obsolete, or even wrong data, removing redundant is the necessary technology to ensure the accuracy and reliability of the data fusion.
The data fusion is a series of processing to deal with the data from multiple sensors. The sensor data fusion is already a long time which is put forward about in the 1970s and widely used in military, biomedical and transportation. The industry has a lot of data fusion system, such as: the Ambite, from university of southern California, put forward the SIMS and Ariadne; and Motro, from the George mason university, raises the Fuskmplex. But, in general, these data fusion systems still have certain deficiencies.

The IT technology emerged in 1950s, and in 70s, it gets a rapid development. The network technology products emerge in endlessly and cover every aspect of life. And their importance to the enterprise is becoming more and more obvious. With the speeding up of world economic integration, the enterprise modernization increasingly relies on the network. The production management system also arises at the historic moment. The production information analysis as a necessary link in the production management system development is of great significance.

**The Collaborative Production Management System**

The Collaborative production management system is the collaboration of social multiple vendors, manufacturers and partners which can achieve the collaboration of the supply chain. The Industrial Internet and the Internet of Things (IoT) is used to transmit data which collects from supply chain to the big data center. After the Oracle Stream in the big data center, the Intelligent logistics distribute to achieve the Collaborative production management system. The system includes intelligent production management system, intelligent resource management system, intelligent quality management system and intelligent decisions making system as shown in the fig 1. The intelligent production management system includes intelligent scheduling, intelligent operation management and intelligent tracing monitoring; The intelligent resource management system includes: intelligent personnel management, intelligent logistics tracking, intelligent equipment test, intelligent maintenance management; The intelligent quality management includes intelligent quality detection, intelligent collection, intelligence quality tracking; The intelligent decision-making includes intelligent reasoning, intelligent prediction and intelligent algorithms.

![Diagram of Collaborative Production Management System](image)

Figure 1. Intelligent quality management system and intelligent decisions making system.

**The Equipment Operation and Maintenance System**

This research takes Equipment Operation and Maintenance System as an example in this paper to show the mechanism of the Collaborative Production Management System. The basis of the Equipment Operation and Maintenance System and the Collaborative Production Management
System is information sharing. Therefore, this paper takes WEB in PC and the client APP as two ways to access each vendor software (ERP, SAP, CRM, PDM and all kinds of graphic files) to interface design which can achieve synergy of settlement system, authority system, dispatching system and reporting system. The product model, equipment files, run log and maintenance records will be gotten through data cleaning. After that the construction of knowledge base and repair plan of equipment will be obtain.

As shown in the fig.2, all kinds of intelligent robot, production equipment will be connected through the RS232 and RJ45 interface. Through the WEB client remote, the equipment production, equipment using and maintenance of professional will be planned. Equipment production include: expert remote diagnosis, process improvement and fault archive; Equipment using includes: equipment aging fault early warning, emergency problem remote assistance, equipment type selection evaluation basis; Equipment operation includes: unified dispatching equipment fault early warning, equipment maintenance, maintenance scheme of intelligent recommendation; Maintenance of professional includes: remote positioning problem reason found, prepare maintenance condition, field request remote support in advance; The main tasks of production and operation are online equipment condition monitoring, early warning, remote diagnosis, spare parts scheduling; The main tasks of using and maintenance are the real-time warning, intelligent recommendation and the preparation in advance.
As shown in the fig.3, above, how to process the big data is the key problem of this study. The first step in the data processing is collection data from the sensors which will connect the product and information. This will make big data preparation and data integrator. Heterogeneous IT infrastructure implementation for large amounts of data will be captured, transformed and delivered through the GodlenGate. After that the Internet of Things (IoT) realize the data networking. The big database will be formed through Oracle Stream. The exploration and mining of data will make in data factories by using Hadoop Platform/Big Data SQL/NoSQL/Oracle DB. Final decision is made like event monitoring, business insight and the data show.

**Conclusion**

This paper analysis of research status at home and abroad, concluded about constructing the key technology of Collaborative Production Management System based on Big Data. The presented research aims to improve the intelligent level of forging industry. A Production Management System framework for the execution of collaborative tasks in enterprises cells is raised in this paper. The Equipment operation and maintenance system as a demonstrate of the system and the Hadoop Platform/NoSql/Oracle Stream and some other technologies are used to handle the big data. The traditional Chinese forging industry ushered in a new opportunity by building an Collaborative Production Management System.

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