RFID Industrial Manufacturing Lean Management Practical Project

The global decentralized commercial VIoT ecochain

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CONTENTS

1 Introduction

At present, smart manufacturing has become the industry's center of attention. After the Ministry of Industry and Information Technology approved 46 smart manufacturing pilot demonstration projects and 94 smart manufacturing projects in 2015 and released the guideline on establishment of the national intelligent manufacturing standard system (2015 version), many enterprises are eager to try and reduce costs by smart manufacturing promotion. Everyone tries to be flexible to respond to the market changes and meet customers' needs better.

2 Overview

The solution applies to automatic collection and management of product information in processing workshops of large and medium-sized manufacturing enterprises. It utilizes RFID wireless radio frequency technology and combines production robots, transmission lines, AGV, and processing equipment. It reduces misreading and missed reading caused by manual operations, ensures seamless docking with the top layer manufacturing information system to realize production process mixing(生产过程混流化), visualization, and intellectualization.

2.1 Project status

At present, manufacturing industry faces the following problems:

- Product process parameters cannot be transferred quickly: each product needs manual processing, transmission, and confirmation of parameters, which is time and labor consuming;
- Mixed production cannot be achieved (无法混流生产): inability to identify different kinds of products and mix the production;
- Products cannot be docked with automated equipment: loader/unloader robots, mixed conveyer lines (混流传送线), AGV etc.;
- Manual scanning is time and labor consuming: because production scale expansion requires manual performance of each operation, a sharp increase in human resources use is caused;
- Fixed-mode scanning recognition rate is low: since paper barcode can be affected by dust and oil

on the production site, barcode recognition rate is low, the accurate operation of the support management system during production line / assembly line information management cannot be achieved.

2.2 Project demand analysis

Several requirements arise out of the problems existing on a project site:

- Recording process quality and tracing information carrier;
- Realization of mixed sorting and flexible production;
- Products docking with automated equipment, smart identification, product information transmission and parameters;
- Barcode system upgrade, usage of RFID technology to realize smart scanning, reduce environmental impact, and reduce labor costs.

2.3 Introduction to RFID technology

RFID (Radio Frequency Identification) is one of the top ten important technologies of the 21st century. At the same time, with its unique advantages and potential in various industries, it is the core technology of the Internet of Things.

RFID is a non-contact automatic recognition technology. Its basic underlying principle is utilization of radio frequency signal and space coupling (inductance or electromagnetic coupling) or transmission characteristics of radar reflection. It realizes automatic recognition of identified objects. In RFID, a tag is a carrier. It communicates with a reader to access a system platform. It realizes the intelligent interconnection of human, equipment, and the system. Besides that, data analysis and full understanding of business processes (业务洞) can be achieved through a management platform.

As the Internet of things core, RFID technology is most widely used in storage management. Its most important advantage is non-contact data acquisition and RFID tag read / write operations. Besides that, high recognition rate, high adaptability, resistance to light, temperature, humidity, dust, grease, and chemical reagents are the reasons why RFID technology is widely used in special environments. Warehouse

management software utilizes RFID technology to collect data and manage daily business, to realize automatic identification, information sharing and tracking, and further enhance market competitiveness in the area of enterprise production efficiency.

3 Solution

Using RFID technology, enterprises can realize an intelligent mixed production line (生产线上智能化混流).

3.1 Intelligent mixed production line 生产线智能化混流

To address the problem of inability of quick product technological parameters transfer on an enterprise processing line, RFID technology can be used to realize the task of information exchange with automated equipment, improve information collection and processing efficiency, and realize flexibility and intellectualization of the manufacturing process.

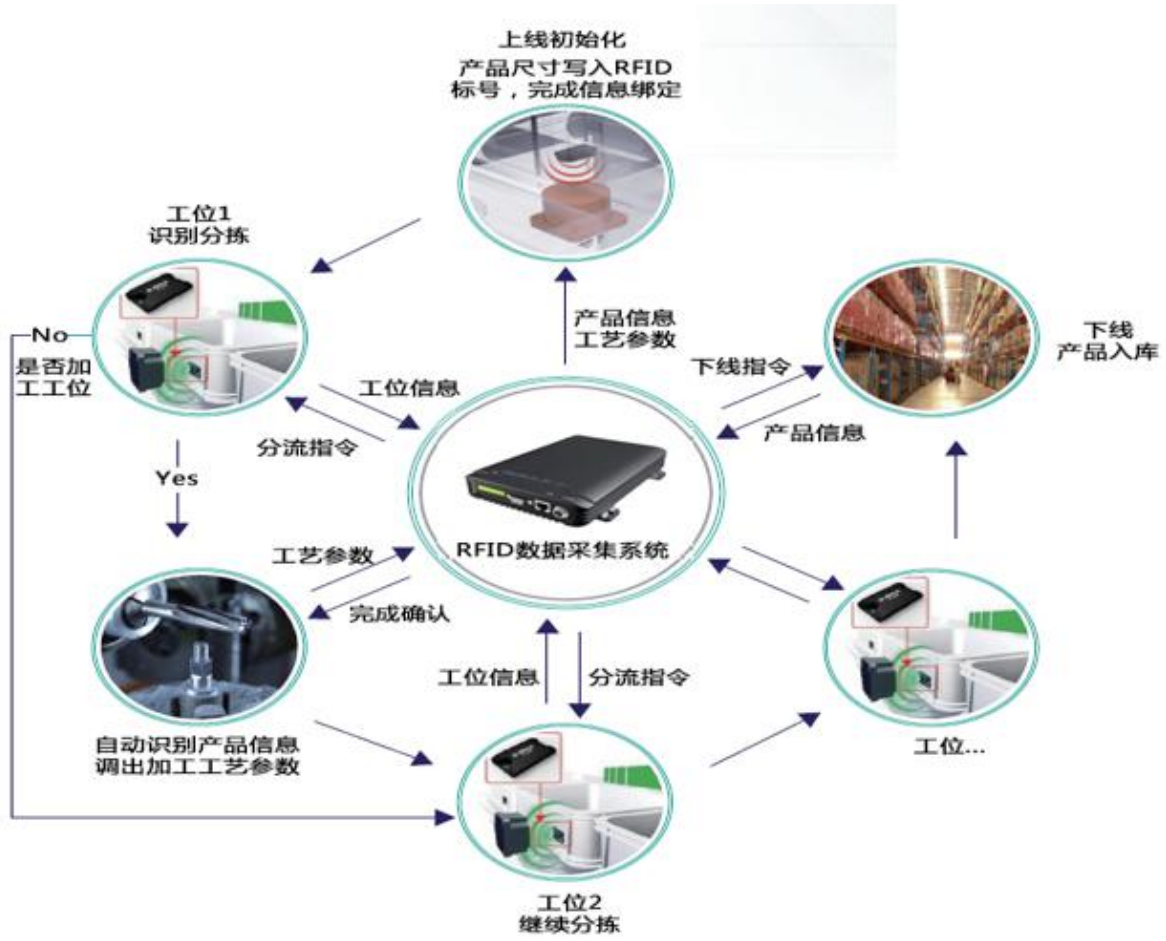


Fig. 1. Processing line smart mixed production process

3.1.1 Carrier application

- When an RFID tag is installed on an equipment board/pallet carrier, product information is written into an electronic label and the production process information carrier is built.

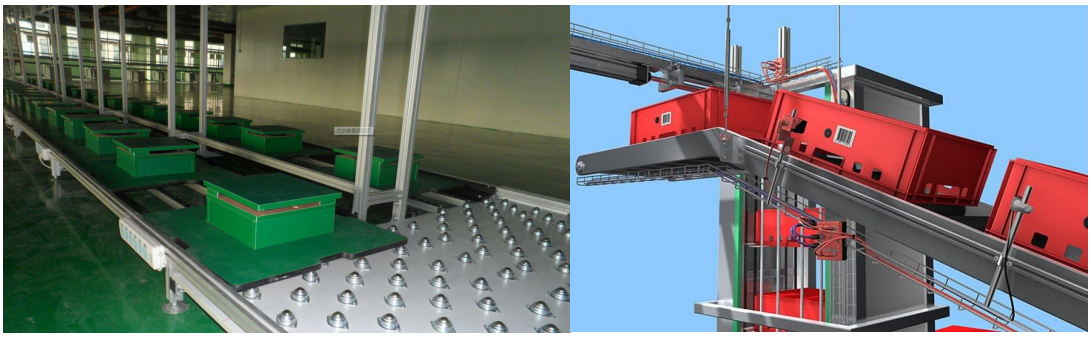


Fig. 2. RFID application as an industrial information carrier

3.1.2 Workplace application

- When RFID reader-writer equipment suitable for industrial environment application is mounted on a processing line, it can read the product information carrier, recognize product information automatically. Together with the upstream control system, using the processing technology, data collection and key equipment docking can be achieved to realize the information exchange with the automated equipment.

Fig. 3. RFID application on a production workplace

3.1.3 Conveyer line application

- When RFID equipment suitable for industrial environment application is mounted on a workshop conveyer line, RFID tags with such characteristics as oil resistance, easy recognition, and non-contact reading mode can replace traditional barcode labels and quickly collect product

information

- According to the information on different products, automatic processing workplace can be organized to perform automatic sorting and realize mixed production.

Fig. 4. RFID application on a production conveyer line

3.1.4 Application effect

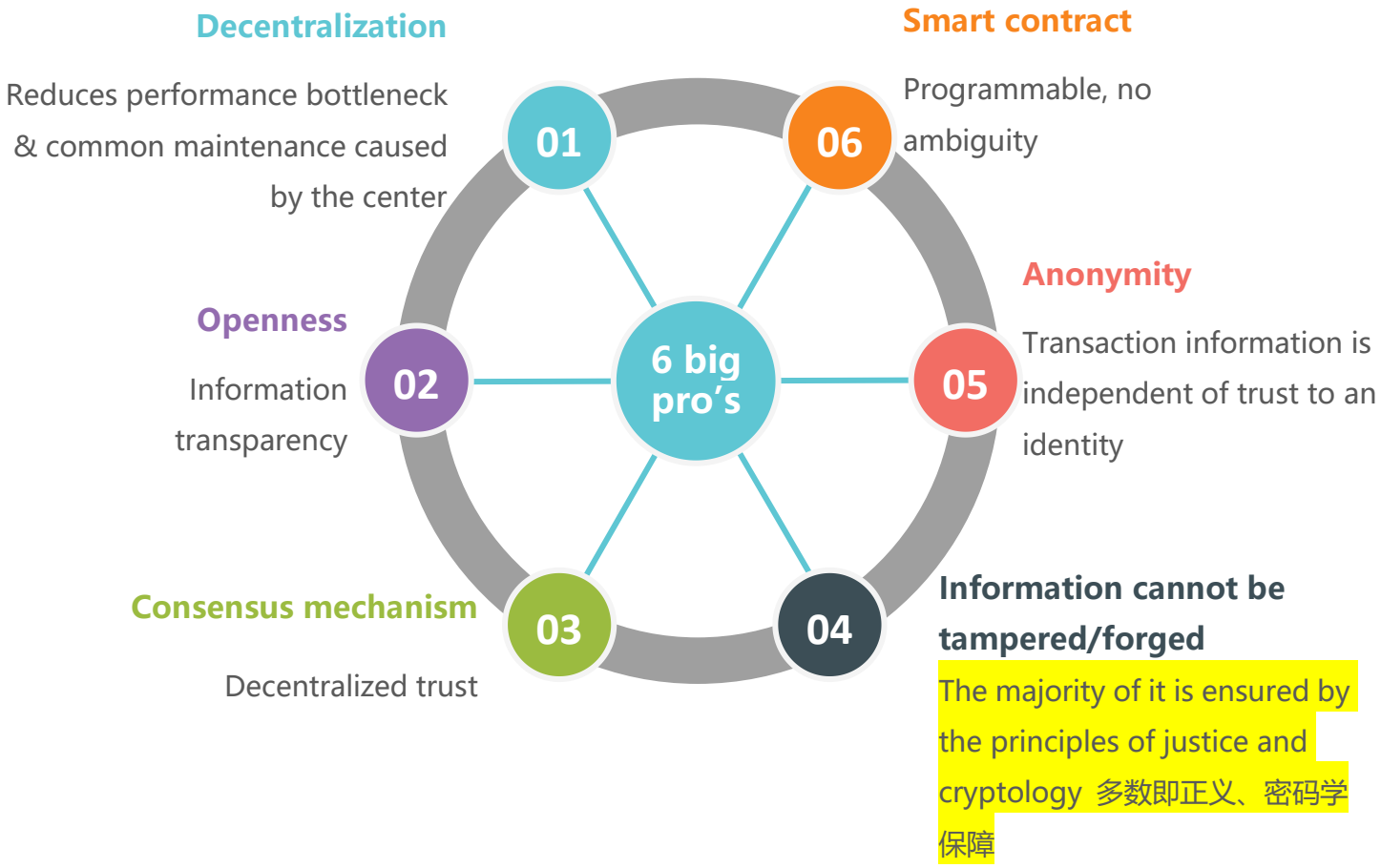
Through utilization of the RFID technology, loader/unloader robot, conveyer line, and machine tool equipment real-time communication can be realized. Automated processing workplaces can be organized for different products. After loading process parameters, automatic multi-workplace sorting, flexible multi-operation production, and multi-type mixed assembly can be realized. Through automation, data collection rate can be increased up to 99%. At each production line, manual scanning time is reduced by more than 90%; production data accuracy is increased up to 90%.

4 Blockchain application

4.1 Blockchain 2.0 concept

Blockchain has distributed data storage, p2p connection, consensus mechanism, encryption algorithm etc. new IT application models. Apart from the original consensus mechanism, its 2.0 generation has programmability as the second key feature. Now according to various business demands, it can create more precise smart contracts.

4.2 Advantages of blockchain 2.0



4.3 Blockchain application explanation

Take the industrial pallet storage system as an example. When a warehouse keeper receives goods, he writes the related attribute information to the corresponding RFID tags and stores the information on the goods in the logistics center database using an RFID scanner connected to a control PC terminal. Having finished this, by means of smart contracts, the system releases the information on the goods in the form of a

transaction. At this point, the information on product style, size, design elements, and other related data is already uploaded to the chain. Likewise, the information on stock-in, stock-out, and sample sending to customers will be uploaded to the chain and stored there. In this way, it will be easy for various links to cooperate to reduce costs and follow up sample source tracing etc.

5 Introduction to the core equipment

5.1 Electronic RFID tag

Product disposable electronic RFID tag

Carrier/pallet electronic RFID tag

This solution utilizes ultrahigh frequency electronic tags with EPC GEN 2/NXP G2XL chips imprinted into sample shoes labels. Below are the technical specifications:

- Chip model: Alien H3 (customizable);
- Chip protocol: ISO 18000-6C， EPC Classic1 Generation 2;
- Operating frequency: 860—960 Mhz;
- EPC area: 240bit;
- TID area: unique 32bit ID;
- Reserved area: can store a kill password and a reserve password;
- Memory: user data storage area 512 bit；
- Storage time: 10 years;
- Rewrite cycles: can be rewritten 100,000 times;
- Etched aluminum antenna;
- Operating ambient temperature (°C): –25 to +85.

5.2 RFID handheld equipment

Technical specifications:

- Supported protocol: ISO18000-6B, ISO18000-6C (EPC CLASS 1 G2) protocol;
- Operating system: Android;
- Storage: ROM: 256 MB / 512 MB NAND Flash, RAM: 256 MB / 512 MB Mobile DDR, expandable with SD cards up to 32 GB;
- Battery: 3.7 V 3400 mAh Li-ion battery (150 mAh spare battery);
- Operating ambient temperature (°C): –10 to +50;
- Relative humidity (%): 5 to 95.

5.3 RFID antenna

IOT-A210 ultrahigh-frequency directional antenna:

- Frequency: 902 to 928 MHz;
- Signal enhancement ratio: 6 to 9 dBi;
- Distance: 6 to 10 m (depends on the environment);
- Standing wave: <1.5;
- Impedance: 50 Ohm;
- Polarization mode: circular polarization / linear polarization;
- Dimensions: 150*150*20 mm;
- Outer covering: ABS front, aluminum shell back;
- Connector: SMA N Female (customizable).

5.4 RFID reader

IOT-R210 stationary reader is a high-performance UHF electronic tag reader-writer. It is designed with completely independent intellectual property rights. Combined with a proprietary efficient signal processing algorithm, while maintaining high recognition rate, it can achieve fast reading and writing of electronic tags. It can be widely used in the fields of warehousing logistics, intelligent store, asset management, book management, financial management, production management, ticket management etc.

- Tag protocol: EPCglobal Gen 2 (ISO 18000-6C) DRM supported;
- Antenna connector: 4-way TNC connector, supports 4 individual antennae;
- RF output: independent read and write mode, 5 to 31.5 dBm output (1.4 W), ±0.5 dBm adjustable;
- Operating frequency: 902 to 928 MHz;
- Operating ambient temperature (°C): –20 to +60;
- Storage temperature (°C): –30 to +70;
- Relative humidity (%): 5 to 95, no condensation.

6 Solution advantage analysis

Below are the advantages of using lean management based on the RFID technology for industrial manufacturing:

1. Flexible production process: the information interaction between a product and automation equipment is realized, automatic workplace distribution is performed according to the working procedure, mixed production is achieved;
2. Manufacturing process intellectualization: quick automatic and efficient data collection, realization of product traceability;
3. High-efficiency lean management: high-efficiency data collection, greatly reduced labor costs, increased enterprise production efficiency, improved enterprise competitiveness;
4. Anti-theft alarm: RFID entrance guard system: effective prevention of samples from being taken out of the exhibition hall or the sample library, enterprise assures produced goods protection.

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