The Applications of RFID on Material Management in Industry 4.0 – Examples from TFT/LCD Industry

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CONTENT

ABSTRACT

The term “intelligent manufacturing” is not only the developing trend of industry but also the critical factor to the fourth industrial revolution. The study here in investigates the synergy of applying RFID (Radio Frequency Identification) technology for intelligent material management based on TFT-LCD(thin film transistor liquid crystal display) factory’s material management system and on production control with Cyber Physical System(CPS) and Internet of Things(IoT) as core technology under the structure of industry 4.0.Facing the industry 4.0 intelligence tendency, the parallel communication and cooperation among machines, equipment, people, materials and products is enabled and smart manufacturing monitor of production flow is enhanced with the assistance of well control over production status collected by the employment of RFID devices that receive necessary data of the whole process from the input of materials to the end of manufacturing, while production and material management information is operated and recorded individually, relying on massive manual operations in neither time-saving nor efficient ways in an industry-3.0-based factory. Moreover, the applications of cloud calculation and big data analysis generated from the real time data of production help to study data-mining strategy for integration and analysis of process flow. Thus intelligent manufacturing on production and material management will be more

productive by the promotion of production application and workshop management flow. The implicit cost of process flow can be lowered, production capability can be enhanced and operators' function can be upgraded as well.

Keywords: Industry 4.0, CPS （Cyber Physical System）, RFID (Radio Frequency Identification), Material Management

CHAPTER 1 INTRODUCTION

1.1 Research background

Looking back at the development of industry, the first industrial revolution, mechanization (1729-1830 Industry 1.0) was driven by water and steam, instead of manpower by machines, evolving from individual craftsman production methods to factory production models. In the second industrial revolution, electric energy from electrification (1870-1920 Industry 2.0) replaced steam power, and the design of assembly lines in factory production lines improved production efficiency. The industrial revolution of electrification opened an era of mass manufacturing, cost reduction, and process time. The third industrial revolution, automation (1950-2010 Industry 3.0) machinery, uses computers and information technology to enhance the development of industrial automation. The evolution of automation has also become the most far-reaching industrial revolution so far. The development of these three industrial revolutions was due to technological progress, changing the existing model of industry greatly increased the productivity of the industry and the new economic development.

The fourth industrial revolution, the core main axis of intelligent (2011-Industry 4.0) intelligent manufacturing oriented, combined with intelligence and big data (Big Data), the technical basis is the integration

of virtual and real (Cyber Physical System, CPS) and the Internet of Things (Internet of Things) , IoT). From the first industrial revolution to the fourth industrial revolution, each industrial evolution represents a great leap forward in the development of new technology and production models, which not only improves productivity, but also changes the production model of factories. The key to Industry 4.0 is to integrate the foundations of the previous three industrial revolutions, plus the integration of physical and virtual to achieve smart production.

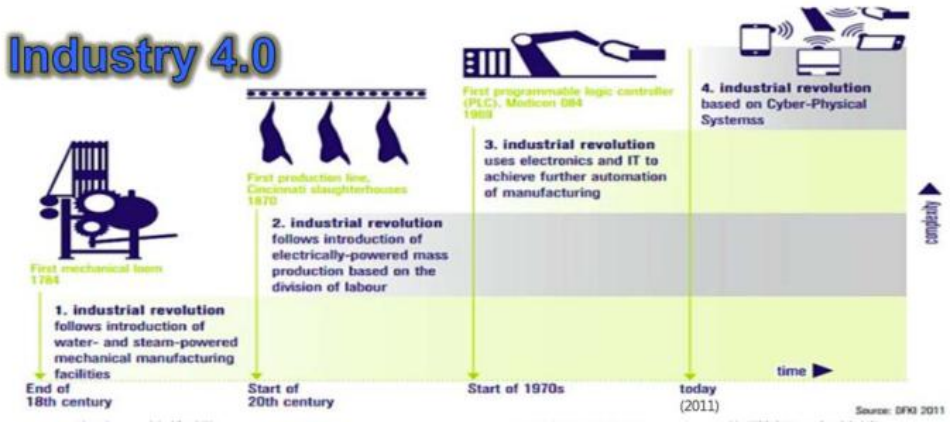

Figure 1-1: Industrial Revolution (Source: Executive Yuan Productivity 4.0 Development Plan)

The German manufacturing industry has a high level of industrial capacity in the world. In order to maintain global competitiveness, it is also aware of the importance of technological change, and solves the global problem of population reduction, labor decline, rapid market changes, shortened product life cycles, and rising raw material costs. Phenomenon, the high-tech strategic plan "Industry 4.0" proposed by Germany at the Hannover Messe in 2011 is listed as one of the ten future plans of the "High-tech Strategy 2020" to consolidate the

country’s production competitiveness.

The "Industry 4.0" proposed by Germany opened the fourth industrial revolution and the development trend of intelligence, guiding governments and industries of various countries to gradually target smart manufacturing technology, actively promoting related virtual and real integration plans, and related policies to revitalize the industry. The smart policies of major countries are as follows.

2011 US "Advanced Manufacturing Partnership" (Advanced Manufacturing Partnership, AMP)

2013 UK "Industry 2050 Strategy" (The future of manufacturing: a new era of opportunity and challenge for the UK)

2014 South Korea "Industry Innovation 3.0" (Industry Innovation 3.0)

2015 Taiwan "Productivity 4.0" (Productivity 4.0)

2015 China "Made in China 2025" (Made in China 2025)

2015 Japan Industry 4.1J (Japan Industry 4.1J)

Smart manufacturing is not only an international trend, but also the key to the fourth industrial revolution. The development of global manufacturing intelligence has become an inevitable trend. It is estimated that the future will promote a new wave of industrial revolution and accelerate the world industry since the third industrial

revolution. Modern industry further guides the development of "smart manufacturing"

Figure 1-2: Major countries' manufacturing promotion policies (Source: Executive Yuan Productivity 4.0 Development Program)

1.2 Research motivation

When the world entered the fourth industrial revolution, governments of various countries began to actively support the development of intelligence in order to maintain their advantages. On the other hand, the pressure of global competition for the development of smart technology and the reality of global population reduction accelerated the transformation of the manufacturing industry. Pressure was born spontaneously. Mainland China also released "Made in China 2025" in 2015 to develop the equipment, technology, software, and communication network infrastructure required for smart manufacturing,

transforming from a large manufacturing country to a manufacturing power from quantity to quality. Facing the trend of industrial intelligence from "Industry 4.0", how to enhance competitiveness has become one of the most important issues at present[1].

"Industry 4.0" is a smart manufacturing-oriented industrial revolution, with virtual and real integration as the core technology, using sensory devices, and a smart factory based on cloud and big data analysis. The introduction of "Industry 4.0" smart manufacturing requires careful evaluation and capital cost investment. At the beginning of the factory, in the process of upgrading equipment automation and networking integration, a large amount of capital needs to be invested in the construction of automation equipment, so when investing Funds and risk considerations need to go through a rigorous evaluation plan. How to invest resources in priority investment that can generate significant benefits and high added value, and seek more effective key points for entering "Industry 4.0". In this case, the company is a world-class manufacturer. The product lines produced by the product line are quite diverse in size and the manufacturing process is extremely Complex, the types and quantities of materials required for production are huge and difficult to manage. In terms of material cost, it accounts for about 50% of the total production cost. Its proportion has considerable influence.

Among them, high-end materials have long delivery times and high costs. , Every important link in the entire production process is involved in the purchase, requisition, feeding, and production, and its importance is even more obvious.

In the "Industry 3.0" production process, the raw materials and production equipment still remain in a self-operating information entity, and most of the material management stays at the stage of manual operation or digital record achieved by the inventory system. In the case of failure, due to the fact that there are many production process parameters and material measurement values that affect each other, engineers can only check machine parameter values site by site, and query form records to verify the measurement values, which is quite time-consuming, which leads to slow transmission of information processing messages. , The abnormal reaction can not be dealt with enough to cause the fault of timeliness between operations. This research explores the intelligent development of "Industry 4.0" material management in the process of transforming into smart manufacturing. Through the integration of virtual reality and the Internet of Things, from feeding production to the end of the process, sensing devices can sense the status of production operations to assist in production. Operation process and monitoring operation process, through intelligent

management so that information can be mutually effective connection, providing useful integrated data, assisting the efficiency of the entire production process and material management, achieving intelligent manufacturing of production management and material management, not only can significantly improve production efficiency, but also prevent hidden costs in the process, and achieve the goal of intelligence.

1.3 Research purpose

Under the framework of Industry 4.0, this research uses the manufacturing process materials and production management as the background to explore intelligent solutions based on RFID radio frequency identification systems.

RFID radio frequency identification system is a kind of automatic identification technology. With mature technology and more and more R&D manufacturers, the cost of installation has dropped significantly compared with the past, making RFID widely used in many fields, such as: logistics management , Assets and equipment management, production applications, medical management, anti-theft applications, traffic applications, anti-counterfeiting management, industrial safety management, access control management, card applications, biometrics, item management, etc.

Using the sensing device to collect a large amount of production-related information through the Internet of Things. From the start of production to the end of the production process, the numerical data in the whole process is collected into the cloud database for data analysis, prediction, mining, and various production management systems and automation equipment The information connection is connected in series to form a virtual and real integration framework to achieve the connection between equipment and equipment, the operation of people and equipment, and the connection between materials and equipment, realize the sharing and integration of production, equipment, people, and materials, and assist the production process to make auxiliary production decisions and manual errors[2].

This study is based on the case company's process materials as a sample for this study, and discusses current operating issues based on the Industry 4.0 framework:

(1)Traditional data analysis capabilities are no longer sufficient to reflect the true cause of the problem

(2)A small number of products, a variety of products, variable schedules, short product life cycles, and insufficient response mastery

(3)Long material delivery time, high price, insufficient logistics information

(4)High process standards, complex product specifications, and high dynamic adjustability

(5)The traditional single-site form statistics method cannot concatenate information

(6)There is no information link between production information and production materials and equipment, and there is insufficient mastery of material information

Aiming at the end of the life cycle of process materials from feed to production, the intelligent operation process research under the framework of Industry 4.0, through this research, hopes to achieve the following goals:

(1)How does industry 4.0 intelligence improve manufacturing efficiency and competitiveness

(2)Link production management and process materials to achieve factory efficiency

(3)Material management achieves smart logistics efficiency

(4)Maximize per capita output value

(5)Production management and yield control and prevention

Chapter2 ANALYSIS OF THE SECURITY OF RFID in Industry 4.0

2.1RFID radio frequency identification technology

2.1.1Introduction Radio Frequency Identification System：

Reading the relevant data by means of radio waves to achieve the transmission of information[3].

RFID has been used in many fields such as: logistics management (material operations, warehousing, inventory, etc.), asset equipment management (fixed assets, items, fixtures, etc.), production applications (equipment control, automation control, etc.), medical management (electronic medical records, Special item management, etc.), anti-theft applications (car anti-theft, store anti-theft, etc.), transportation applications (electronic highway tolls, MRT systems, etc.), anti-counterfeiting management (valuable certificates, confidential documents, etc.), industrial safety management (special work spaces, etc.)), access control management (access control monitoring, personnel management, etc.), card application (Smart card, leisure card, ID card, etc.), biometrics (pet identification, wild animal ecological tracking), item management (luggage identification, logistics transportation, etc.) are widely used.

The radio frequency identification system originated from the development of the British (1948) during the Second World War[14] . The IFF (Identify Friend of Foe) system was used to identify the use of enemy or enemy fighters, and related papers after 1950. It was published; in 1973, Mario Cardullo obtained the first American active RFID tag (Radio Frequency Identification Tag, RFID Tag) patent; Charles Walton obtained another patent for passive RFID tags. After 1975, RFID technology began to be commercialized and popularized.And then it is widely cited and developed for different purposes by countries all over the world.

The radio frequency identification system is regarded as one of the ten most important technologies of the century. In 2005, Wal-Mart, the leader of the global department store retail industry, began to apply RFID tags to speed up the efficiency of the supply process. This has led to the application trend of RFID among industries [4]. Technavio (Infiniti Research Ltd.) research shows that the global industrial RFID market will continue to grow rapidly at a compound annual growth rate of 19.2% from 2016 to 2020[17] . The barcode system is not only time-consuming, but also the risk of high error rate due to manual data input, while RFID can automatically identify data and record more accurately. With the continuous development of industrial technology, industrial RFID is

developing rapidly [17]. The global RFID market is predicted to reach a scale of 13.2 billion U.S. dollars by 2020[18].

The RFID system is mainly composed of a reader (RFID Reader) Figure 2-7, RFID radio frequency tag (RFID Tag) Figure 2-8, Antenna (Antenna) and application system (Application) Figure 2-6, using RFID to read The device emits radio waves, drives the RFID radio frequency tag within the sensing range through the antenna, and transmits the data of the RFID radio frequency tag to the reader through the principle of electromagnetic space coupling of radio waves to realize non-contact information transmission applications[5]. Then through the back-end application system for information interpretation and use, to achieve the purpose of identification[13].

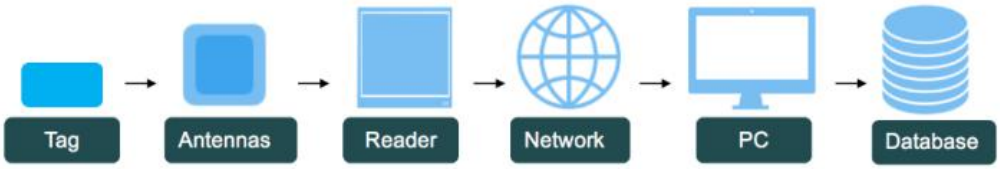

figure 2-6: Schematic diagram of RFID operation

Figure 2-7: RFID Reader (Data source: micro program information https://www.program.com.tw, 2017)

RFID tag (RFID Tag) is the data carrier of RFID radio frequency identification system[15]. Figure 2-8 is composed of chip (Substrate) and antenna coil (Antenna Coil). Each tag has a unique electronic code. , Stores the electronic mark information for identification, and can be divided into read-only and readable and writable according to its capabilities.

The RFID radio frequency tag is attached to the identification object to identify the target object. When the RFID reader emits radio waves to generate electromagnetic principles, the RFID radio frequency tag will return a unique electronic code after re ceiving the reader signal for the RFID reader to process and identify[6].

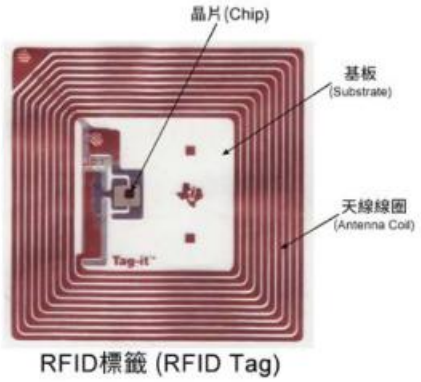

Figure 2-8: RFID Radio Frequency Tag (RFID TAG) (Source: TI.com,

compiled by Digitimes, 2014) [16]

RFID radio frequency tags can be divided into active (Passive Tag) and passive (Active Tag) two types:

Active RFID tag (Figure 2-9): It contains a battery, and the energy driven by its own battery actively returns data to the RFID reader.

Advantages: long transmission distance and large memory capacity.

Disadvantages: high cost, limited battery life

Figure 2-9: Active RFID Radio Frequency Tag (RFID TAG) (Source: Microprogram Information https://www.program.com.tw, 2017)

Passive RFID tags (Figure 2-10): The principle of electromagnetic generation by radio waves emitted by an RFID reader

Advantages: small size, low cost, long life.

Disadvantages: short distance, one-way information transmission.

Figure 2-10: Passive RFID radio frequency tag (RFID TAG) (Source: Metalcraft, Inc., 2017) [20]

Table 2-2: Comparison of RFID active and passive tags

Active and passive label comparison	Active	passive
Power source	Battery powered	Electromagnetic drive
cost price	higher	lower
Reading distance	Far (video rate)	Near (video rate)
Service life	Limited battery	No battery, unlimited
Memory capacity	Large: Read and write	Small: Read Only
Size	Large: Depends on battery size	Small: like a sticker

In addition to the difference between active and passive RFID radio frequency tags, the following common RFID system frequencies can be distinguished according to the different frequency bands between electronic tags and RFID readers: Low Frequency (LF), High Frequency (HF), Ultra High frequency (Ultra High Frequency, UHF) and microwave (Microwave, MW).

frequency	Low frequency	high frequency	UHF		microwave	
Read range	LF 120~150KHz	HF 13.56 KHz	UHF 866~928KHz; 433KHz		MW 2.45~5.8 GHz; 3.1-10 GHz	
System Type	passive	passive	passive	Active	Active	Active and passive

Read range	<10cm	<1m	<12m	<100m	<2m	<200m
Data speed	low	medium	Mid to high	medium	high	high
Scope of application	Animal identification Merchandise management Access control	Smart ticket card Access control	Material management asset Management Defense applications		highway Electronic Toll	

Table 2-3: RFID system frequency specifications and characteristics [15;16]

2.1.2The difference between RFID and Barcode

With the widespread use of RFID and the maturity of the automation environment, radio frequency identification systems have gradually received industry attention and applications. RFID has the advantages of non-contact sensing and reading and writing. It can read a large amount of radio frequency tag information at one time, and maintains good object penetration in non-metal and liquid environments.

Within the scope of the radio frequency identification system, radio frequency tags can actively return information to the RFID reader. Compared with traditional barcode tags (Barcode) Figure 2-11, the use of photoelectric effect can only read one dimension at a time The bar code label method, the radio frequency identification system has a high degree of automation, in addition to saving a lot of manual time, but also reducing the incidence of human error.

Figure 2-11: Barcode label (Barcode)

In summary, RFID technology has better performance than traditional tags in terms of sensing method, reading and writing ability, distance, usability, penetration, and service life.

The differences between RFID and Barcode are explained as follows: Table 2-4[19]

	RFID	Barcode
Number of reads	High: can automatically read multiple tags at the same time (> 100)	Low: The label can only be read manually, and only one can be read at a time.
Read directionality	No need: as long as the tag is within the reading range, no specific directionality or direct line of sight is required	Absolutely necessary: the scanner needs to scan directly in a very specific way
Labor costs	Almost none: once running, the system is fully automated	Manpower hours: The operator must scan each label.
Literacy	More than just reading. With the ability to read, write, modify and update	Can only read
Service life	high. High durability, and can be read in very harsh environments	low. Easy to damage or break; dirty or greasy can also make it impossible to scan
safety	high. It is difficult to copy data and can be encrypted and protected, so the stored information is more secure.	low. Easy to be copied or forged

2.2 Security issues based on RFID

The following is the definition of data security in RFID[8]

(1)Access to data is restricted: information that is read and written to the database needs to be authenticated.

(2)The access system is restricted: all devices of the access system must be authenticated and trusted.

(3)The system is safe and trustworthy: the most basic point is that the system must be safe and reliable.

RFID technology has shortcomings in terms of security and privacy. The security of RFID systems mostly depends on the development of middleware and the data contained in RFID tags. These data may cause SOL injection attacks, denial of service attacks, and buffer overflows[7].

2.2.1RFID security threats

(1) Sniffing. Any corresponding reading device can read the tag information, and the reading behavior does not need to be aware of the tag load, and it can happen at a long distance.

(2) Tracking. The reader can record a unique visual tag identifier at a specific location, and then associate it with personal identity.

(3) Respond to the attack. Attackers use answering equipment to intercept and forward RFID queries[6].

(4) Denial of service. Denial of Service (DoS) prevents the RFID system

from working normally, such as signaling congestion will prevent the communication between the radio frequency wave and the tag.

2.2.2 RFID risk

(1) Data read error. Network errors, virus infection of middleware, or signal interruption during data transmission can occur, which can lead to inaccurate statistics.

(2) The disclosure of business information. The attacker illegally accessed the RFID system to obtain commercially sensitive information.

(3) Personal privacy is exposed. Obtained by tracking the label residing in the product Customer's residential address and some personal information.

(4) External risks. When the RFID system is connected to external networks, these networks the attack will indirectly or directly threaten the FRID system.

2.2.3 Security issues related to RFID communication

Tag readers have two communication methods: transmitting data via Internet Protocol (IP) and providing and collecting data sent or arriving at the tag via low-power radio (radio frequency, RF). Both methods have some security issues.

(1) Data transmission via IP

Unauthorized access to the network is an important security threat, and any malicious device should be prevented from accessing the network.

The use of technologies such as SSL and SSH can ensure network security. These technologies close some ports that can be maliciously used by attackers to ensure that the system is more secure. More security tools and higher technical standards make this communication method relatively safe.

(2) Provide and collect data through low-power RF

This method is carried out in the air and will cause some serious threats:Unauthorized tag access (resulting in sniffing). In theory, all tags should be authenticated by an RFID reader before being read. However, a loophole in the tag allows a fake reader to read the complete information in the tag, write arbitrary malicious data into the tag, and even terminate or destroy the tag. Since the tag can be read anywhere within the range of the RFID reader, it can be used to steal a digital passport[6].

Cloning tags (resulting in deception). A cloned tag is an unauthorized copy of the original tag, and the reader will read it as the original tag, so the reader can be accessed illegally. Cloning tags will inject erroneous or malicious data into the system, destroying the integrity of the system and the data in the system[9].

Channel attacks (resulting in replay attacks). At present, the biggest security threat is that malicious devices eavesdrop on their communications between tags and readers, and wait for opportunities to steal passwords and other sensitive information, which will also lead to man-in-the-middle attacks.

2.3 RFID-based attacks

2.3.1 Buffer overflow

Buffer overflow is the most common type of software attack. Buffer overflow means that when the computer fills the buffer with the number of bits of data that exceeds the capacity of the buffer itself, the overflowed data is overwritten on the legal data.Buffer overflow means that the intruder directly (such as user input) or indirectly (through environmental variables) input data, the input data is greater than the length of the buffer allocated to the memory, so that it overflows and overwrites the legal data. The location of the program control data in the memory is usually adjacent to the data buffer, and the buffer overflow makes the program execute the code at will. RF ID tag buffer overflow will endanger the security of the middleware back-end system. The tag data is generally less than 1024bit, but the "write mu-hiple blocks" command in 150--15693 allows tags to repeatedly send the same data module, which will eventually fill the application layer cache.

2.3.2 SQL injection

SQL injection is caused by security vulnerabilities in the database layer of the application. It is an attack technique that uses the Web site to alter the background SQL statement by forging the requester's input. In RFID systems, this kind of vulnerabilities are common in middleware. There are several methods for SQ L injection, including incorrect filtering of escape characters and incorrect type conversion.

The middleware reads the data from the RFID reader, and because it does not involve the database, it cannot carry out any meaningful attacks on the database. For example, if a person wants to enter a room, he needs to be authenticated. The RFID tag contains the person's ID number and name. The middleware will use SQL query statements to authenticate. If the query returns a non-null value, the person can enter the room. . Attackers can use incorrectly filtered escape characters to perform SQL injection, so that the query result will always return a non-null value; this will also lead to a denial of service attack, that is, delete the query during SQL query the table makes no one can be certified. It is more dangerous when the database is connected to the network or the Internet, especially when SQL statements are executed through Web sites and URLs.

2.3.3RFID-based worm

Worms are programs that use security flaws in applications to propagate themselves through the network. Worms do not need to be artificially propagated. There is usually a load to perform tasks such as deleting files, sending information through email, inserting software code, etc. The most common load is to open a back door on the infected host to facilitate the attacker to enter the computer in the future system.

RFID worms[10] use vulnerabilities in RFID online services to spread, and do not require users to do anything (such as scanning RFID tags). Its spread starts when the RFID worm finds an RFID middleware server through the network for the first time and infects it. RFID worms can also pass RFID The tag spreads, and the RFID middleware infected with the worm will use the vulnerability on the tag to infect the RFID tag. This vulnerability allows the new RFID middleware server to download and execute a file remotely. The file will be infected in the same way as standard malicious code RFID middleware.

2.3.4 RFID-based virus

Unlike the RFID worm which relies on the connection between the RFID system and the network, RFID virus does not need to connect to the network. As long as the RFID-based vulnerability can be used to independently copy its own code to a new label program, the RFID virus

may or may not have a load. . When a newly infected RFID tag is used, the tag will infect other RFID systems (assuming the same software system is used); the infected RFID system will infect other RFID tags, and these tags will then infect another RFID system, so that the infection will be repeated to spread the virus .

2.3.5 Fragmented malicious code based on RFID

Malicious codes pose a great threat to users of RFID application systems, but these codes also have some problems. For example, due to the limitation of the memory size of RFID tags, some malicious codes can not be completely put in the tags due to their large size. ; The complete malicious code in the tag is easily found by the victim and the protection software. In order to solve these problems, a fragmented malicious code based [11]on RFID is proposed. The method first divides the malicious code into several fragments according to the total size of the malicious code and the available space of each RFID tag, and puts them into the RFID in turn. Within the label. In the middleware, the fragment data will be submitted to the database server in the format of SOL query statements. These fragments are stored in a separate table in the database, and this table must be created before all fragments are read by the RFID reader. For this a special label must be prepared to create this table; a separate label is prepared for storage including fragment merge and trigger.The data of the mechanism, once the tag is read, all

the fragments will be merged into a single executable file-the malicious code created by the attacker, and the executable file will be triggered.

2.4 Malicious code immune model based on RFID system

At present, there are still few detection models for malicious code in RFID systems, and most of them are based on traditional signature detection. The detection efficiency is low and cannot well fight against current malicious code attacks based on RFID systems. For this reason, this paper proposes based on RFID. The system's malicious code immunity model.

2.4.1 Precautions

In order to deal with RFID-based attacks, there are two parts that need to add defense mechanisms, namely middleware and database, these two parts are the main components of the RFID system. In this regard, rieback proposed a series of defensive measures[12] against RFID malicious code, which are also effective against fragmented attacks. These defensive measures include:

(1)Check the middleware code;

(2)Lock user account;

(3)Close or delete unnecessary attributes;

(4)Avoid SQL injection by prohibiting copying data to SOL statements and allowing a statement to be queried only once;

(5)Restrict or prevent the function from obtaining the current query to

prevent the spread of the virus;

(6)Turn off SSI to avoid network-based attacks;

(7)Strictly check the buffer boundary to prevent buffer overflow

2.4.2 Security Strategy of Immune Model

According to the characteristics of each part of the RFID system, this article gives the corresponding security strategy for each part

(1) RFID tag

RFID tags are used to store data and rarely contain SQL statements. It is possible to prohibit the use of SQL statements in RFID tags, and SQL statements should be used in middleware. When designing an RFID tag, a security mechanism is established in the tag. When the user writes data, the mechanism checks the written data. If it is an SQL statement format, it will alarm and remind that the format is not allowed, otherwise the data is safe. . At the same time, make sure that the label does not contain hexadecimal data, because the malicious code is likely to be converted to hexadecimal and stored in the label.

(2) RFID tags and readers

When using RFID tags for fragmented attacks, generally attackers will choose to use their own tags, which is convenient for storing data constructed by the attackers in the tags. In order to prevent such unauthorized tags from accessing the RFID reader and attacking the database server, the authentication between the RFID tag and the reader

should be strengthened. The signature mechanism in cryptography can be used to make the tag have a special signature. When the tag enters the reader's readable range, the reader first reads the signature of the tag, and then reads other data after confirming that it is the correct signature , The process is shown in Figure 2-12.

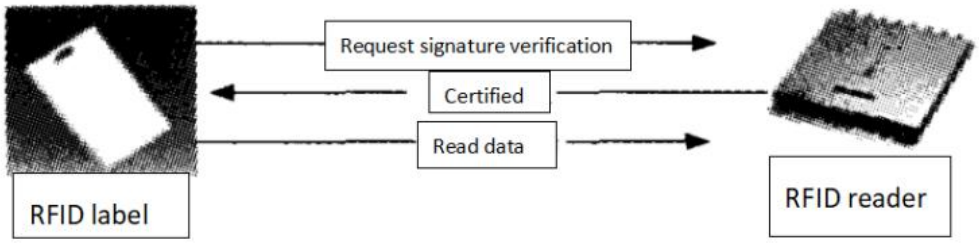

Figure2-12The authentication process of RFID tags and readers

(3) RFID reader

The RFID reader does not need too many bytes to create a tag ID. Count the number of bytes required by the reader to create a tag ID. After summarizing, take the maximum value as the upper limit for the reader to read the data in the tag. When the data read by the reader exceeds the upper limit or read the entire RFID tag, an alarm will be given

(4) Middleware and database

Use only one middleware and a database separated from other systems as much as possible, so as to prevent malicious code from spreading to other systems. If you want to connect to the network, it should be done in a controlled environment. When merging data from an RFID database and transferring it to another database via the network, a firewall should be configured so that the data is only transferred between databases. Of

course, manual transfer (such as through a USB flash drive) will be more secure. Generally speaking, the normal data in the RFID tag does not need to be merged into executable files.Therefore, the shell commands in the RFID database should be shielded from commands with similar functions.

2.4.3 Malicious code immunity model

According to the above security strategy, this paper designs the evil based on RFID system: the code immune model. The model is divided into two parts: the innate immune system and the adaptive immune system. The innate immune system is mainly used to detect whether the data is legal and malicious code; the adaptive immune system detects data that is not in the signature library of some malicious codes. , The behavior detection method is used in the detection process, and its model is shown in Figure 2-13.

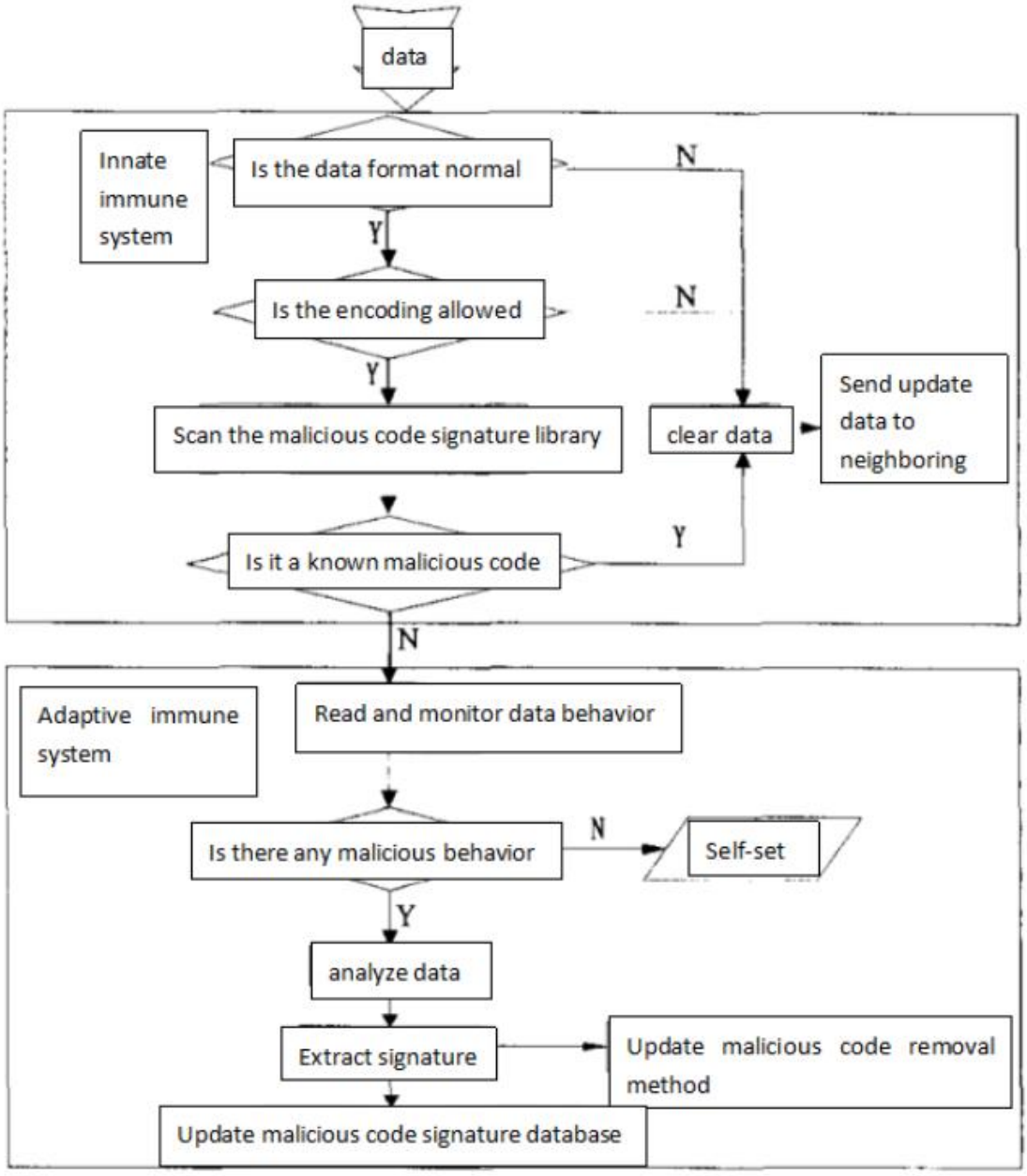

Figure2-13 Malicious code immune model based on RFID system

Chapter3 RESEARCH CASE INTRODUCTION

3.1 Case company profile

The case company is located in the Science Industrial Park for Thin Film Transistor Liquid Crystal Display Design, R&D and manufacturing company, currently supplying a few in the world manufacturer of large, medium and small complete product lines.It can provide the panel products required by various liquid crystal display applications products, products cover a wide range of TFT-LCD panels from 1.2 inches to 85 inches.

Main products:Thin Film Transistor Liquid Crystal Display(TFT-LCD),Low Temperature Poly-silicon； LTPS,Active Matrix Organic Light Emitting Display； AMOLED Operating bases in China, Japan, Singapore,World operations bases in South Korea, the United States, and Europe.

Large-size panel market share is 16.3%(IHS, Large Area Display Market Tracker， January 2017),One of the constituent stocks of the US Ocean Tomo 300® Patent Index.As of March 2017, the cumulative number of patent applications has reached 23,100, and the total number of patents worldwide has exceeded 17,100.

Figure 3-1: Thin Film Transistor Liquid Crystal Display (Source: AUO.COM) [19]

3.2 Description of the company's current situation

The TFT-LCD production process is quite cumbersome and complicated. In the case, the company has developed a high degree of automation in machine production, and the production raw materials and production equipment at the factory side are still not connected to each other, staying at the stage of inventory reached by the material system, traditional forms The stage of recording data and checking management.

The inventory system is a simple system for recording and recording. It does not use the help of information technology to assist material management, production management, and data analysis. The manual

writing method of traditional forms cannot provide real-time production exception prevention. The materials are in production. The generation of useful data has not been used and analyzed by value, and the manufacturing process is becoming more and more complex. With a small number of diverse ecosystems, relying on the experience and analysis of the operators can no longer meet the needs of modern industry for such complex management and collaborative optimization.

The company currently relies on manpower and form operations in handling material inventory, manufacturing, management, and tracking.These process materials are very expensive, important and closely related to production. Any poor quality parameters and human errors in the materials will affect product quality or lead to serious product scrapping.

In the case of the company’s production costs, materials account for about 50% of the total production costs. Therefore, effective control of materials and connection of production information will be a very effective topic for the intelligent promotion of "Industry 4.0". This research will use RFID radio frequency identification system , The intelligent material management based on technology, connects raw materials and production equipment in series through the Internet. On

the other hand, with the development of sensor technology and the Internet of Things, the cost of sensing real-time production materials is no longer required setup cost.

The operating areas in the factory of the case company include: "material inventory area", "production picking area", "material measurement area", "feeding storage area", "fixture operating area", and "machine operating area" ”, “Jig storage area” and other areas, each operation stage is interlocked, the RFID system process design analysis case company’s process materials from storage to the end of the life cycle are identified by the RFID system during the operation , Tracking, monitoring and management, and through the integration and application of the system and the system, the virtual and real integration of human, machine, and things to achieve a synchronized integration, through the cloud and big data analysis-based smart manufacturing.

The schematic diagram of the operation area in the factory of the case company is shown in Figure 3-2 and Figure 3-3. The operation area includes:

Figure 3-2 Material inventory area, production picking area, material measurement area

Figure 3-3 Feeding storage area, tool operation area, machine operation

area, tool storage area

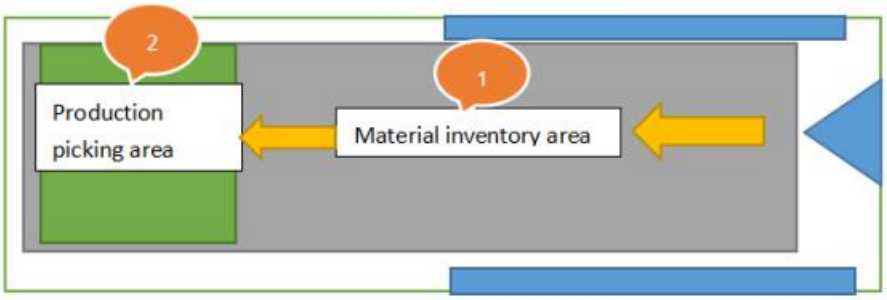

Figure 3-2: Figure 1 of the relative location of each area on the site of the case company (material inventory area, production picking area)

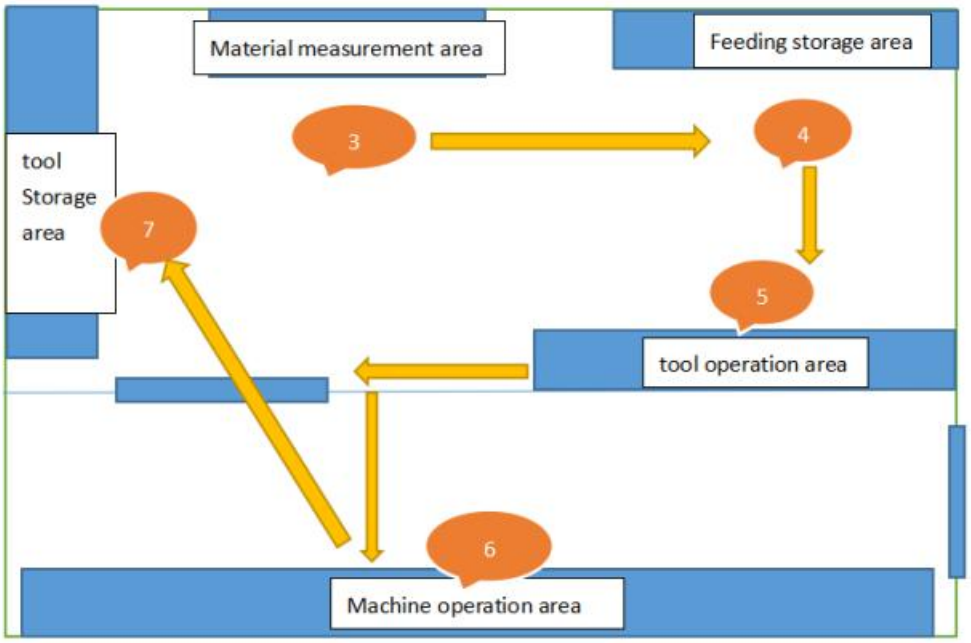

Figure 3-3: Figure 2 of the relevant location of each area on the site of the case company (material measurement area, feeding storage area, jig operation area, machine operation area, jig storage area)

3.3company may encountered security issues in the future

The low cost and small size of RFID tags restrict the realization of various security technologies, so that there is no Law provides privacy protection function.

With the application and promotion of RFID technology, RFID privacy issues will be involved in the fields of logistics, merchandise sales, supply chain management, etc. However, different areas the RFID technologies used by domains are not the same, so the privacy threats they face are also different., In the logistics field, users are mainly enterprises, so their privacy threats are mainly.It is sensitive information about the company's inventory, product transportation process, etc.

Chapter 4 RESEARCH METHODS AND ANALYSIS

The research methods and analysis in this chapter first explain the RFID radio frequency identification system equipment and related auxiliary hardware equipment specifications used in the research methods, and then explain the design and process analysis of the RFID system in each area, based on the "analysis of existing operating modes", The three parts of "intelligent design and process analysis" and "RFID import effectiveness analysis" are analyzed and explained.

4.1 Hardware specifications

RFID technology application and auxiliary hardware equipment specifications, application instructions are as follows:

(1) RFID UHF Reader: YRU-150 RFID UHF Ultra High Frequency (Ultra High Frequency) reading device, frequency 902 to 928MHz, the reader is installed above the mechanism, through the antenna (Antenna) device, receiving RFID UHF Tag signal

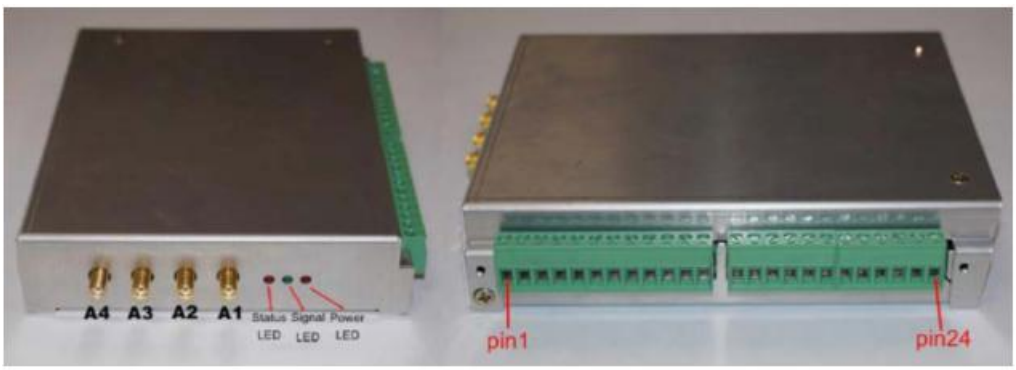

Figure 4-1: RFID UHF Reader (Source: Microprogram Information https://www.program.com.tw, 2017)

(2) RFID Antenna: Antenna device, a device used to transmit radio frequency signals between an RFID reader and an RFID tag.

(3) RFID Tag: RFID wireless radio frequency tag, a radio transceiver composed of an integrated circuit and antenna. Passive RFID TAG does not need a battery to receive the radio frequency electric field emitted by the identifier to generate magnetic force. When the RFID tag receives the energy signal source that the Reader generates the radio signal, the Tag responds with the information to the RFID Reader.

(4) RFID UHF Tag: RFID UHF (Ultra High Frequency) passive tag, reading range: 100m, frequency 902 to 928MHz, transmission speed: medium speed

(5) RFID management terminal: M180L has a built-in RFID smart module, programmable design, with card reader EM, HID, Mifare sensor module, controller and voice functions, and LCD visual screen. MP180L is a small smart terminal control device that can easily communicate with the back-end control host through the Internet of Things. It has a built-in Linux operating platform. Application system developers can quickly respond to the needs of various application scenarios through the SDK development kit. Benefits and changeable applications.

Figure 4-2: RFID management terminal (data source: microprogram information https://www.program.com.tw, 2017)

(6)RFID HF sensing device: It is an extension sensing device module for the RFID management terminal M180L, and the antenna module is designed to return RFID HF TAG signals to the RFID M180L management terminal.

(7)HF Tag: RFID high frequency (High Frequency) passive tag, reading range: 3~5cm, frequency 13.56MHz, transmission speed: medium speed

(8)HID identification card: It is the current specification used for employee identification card, non-contact smart card technology, frequency: 125KHz, card reading distance: 3.8 ~ 10.2 cm, using PVC surface, can use most direct imaging printers to make photo ID on site Card, typically used in access control systems, inspection systems, time attendance systems, and other radio frequency identification fields. It provides two-way authentication and a 64-bit diversified key for encrypted data transmission to ensure a high degree of security.

(9)Tablet PC: ASUS ZenPad S8, Android 5.0 8" QXGA LED

(10)IOT cloud intelligent gateway: based on IEEE 802.15.4 protocol specification, wireless intelligent controller. The cloud technology is combined with the Zigbee intelligent Internet of Things technology to act as a coordinator in the Zigbee network, which can automatically add and configure the network

(11)IOT wireless sound and light alarm: an emergency alarm loudspeaker device designed based on the ZigBee standard. It can be added to the Internet of Things and bound with other devices. After receiving the trigger signal of the device, it will sound an alarm and a visible LED indicator.

(12)Barcode Scanner: NX-1100 Desktop Barcode Scanner, connected to USB, RS232, can interpret all standard one-dimensional and two-dimensional barcodes.

4.2 RFID system design and process analysis

This time, it is implemented in the production site of the alignment film printing (TFT-LCD Rubbing process) in the TFT-LCD Cell process (Figure 4-3), and the process material Rubbing Cloth (Figure 4-4) is taken as an example , This process material undergoes nine work area processes in the production process. The life cycle process can be divided into: "material inventory area", "production picking area", "material measurement area", "feeding storage area", " Processes such as "Jig operating area", "Machine operating area", "Jig storage area", and

system design and process analysis instructions for each area are based on: "Analysis of existing operating modes", "Smart design and process analysis" Three parts of "Analysis of RFID Import Effectiveness" will be analyzed and discussed:

(1)"Analysis of existing operation mode": Explain the problems faced by the old operation flow method and manual operation method before the introduction of intelligence

(2)"Intelligent Design and Process Analysis": Explain the main functions of RFID technology application methods and auxiliary equipment and the way of intelligent process design

(3)"Analysis of the effectiveness of RFID import": The use of RFID sensing devices to communicate through the Internet of Things to achieve the benefit analysis of the series of information such as people, machines, materials, etc. The research experiment data is calculated by averaging the total number of actual measurements during the test period. Compare the before and after benefits of manual work time before and after intelligentization.

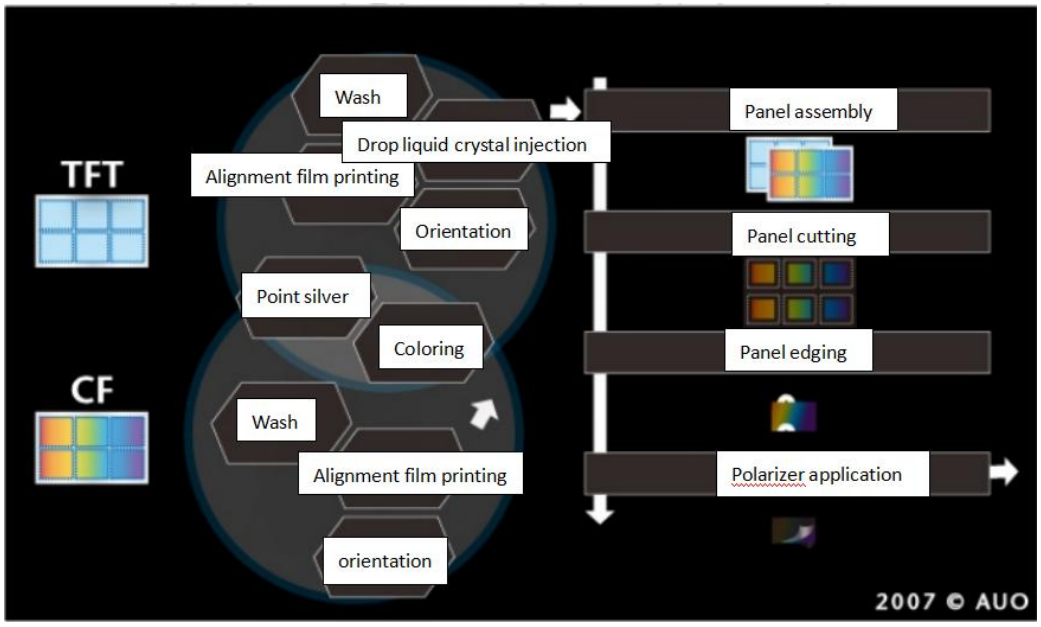

Figure 4-3: TFT-LCD Cell manufacturing process (Source: auo.com, 2017) [21]

Figure 4-4: Rubbing Cloth (Source: teanaka.com, 2017) [22]

4.2.1 Material inventory area

A. Pre-existing operation mode analysis (AS-IS)

The operation process includes: raw material procurement, purchase scheduling, supplier delivery, warehousing operations, material operations, and inventory operations

(1)**Procurement of raw materials:** The purchaser calculates the estimated demand and consumption of materials based on the future production forecast schedule (customer orders) and the current remaining inventory in the "material inventory area". The calculation method is completed by manual trial calculation to determine the actual demand After the quantity, place an order to purchase from an international raw material supplier

(2) Purchase schedule:

(a) For materials ordered from international raw material suppliers, the purchaser will use a predictive method to schedule the delivery dates in batches, and the raw material suppliers will deliver them to the warehouse according to the designated delivery dates of each batch

(b) The purchaser will issue a material picking list to the material operator in the manufacturing department one day before the delivery date of the material, as the basis for the operation

(3)**Supplier delivery:** The raw material supplier will deliver the materials to the warehouse on the designated delivery date. The warehouse

management staff will check the material item, material number, quantity and appearance risk after confirmation and inspection, and after the receipt of the raw material supplier's bill, the warehouse management The personnel transfer the materials from the warehouse to the raw material warehouse of the manufacturing department, and hand them over to the manufacturing department for arrangement and distribution.

(4)**Inbound operations:** After the warehouse materials have arrived, the material operators in the manufacturing department will confirm the inbound materials picking list, including: item, item number, quantity is correct and appearance inspection, in the Materials System (record the material inventory quantity) In the information system), one-dimensional barcodes of physical materials are scanned through a wireless barcode machine, and each box needs to be scanned two to four times. Complete the bar code operation of the accounting material for the quantity in the warehouse on the day, and then place it in the designated storage location according to the different material items, and report the receipt to the purchaser to ensure that the materials in the warehouse on the day have been put into the warehouse on schedule.

(5)**Material operation:** After the purchaser receives the notification of the material input completion of the material operator in the manufacturing department, the material specification data provided by

the material supplier must be imported into the material system for information creation. This information is used for subsequent production operations inquiries.

(6)**Inventory work:** In order to maintain the correctness of the inventory quantity, the inventory quantity in the "material inventory area" is counted once a day, and the material operators of the manufacturing department take the inventory list to check and confirm one by one, and notify the purchaser to adjust the inventory data if the inventory does not match Maintain the integration of accounts and materials to facilitate material management operations.

From the above explanation, the existing problems in the operation of the existing "material inventory area" can be summarized and explained as follows:

(a)Inventory count quantity information is established based on the actual count of on-site inventory by operators. The correctness of manual information input will affect the correctness of inventory quantity

(b) If the material operator fails to make a return in the existing operation, the purchaser needs to confirm to ensure that the material received on the day is stored on schedule

(c) Whether there is a return or forgetting to return after the personnel receives the materials, which causes the inventory information to be

unclear and the accounting is incorrect. If there is an abnormal situation, the processing will not be timely and the efficiency will be poor.

(d) One-dimensional barcode scanning operation requires long working hours and many procedures, and it is prone to the problem of missing barcode scanning and unfinished account establishment.

(e)The inventory of raw materials is counted once a day. There will be inventory errors caused by time differences before the inventory time, and there is a period of inventory information gaps for purchasers.

(f) Raw material procurement, purchase scheduling, and manual administrative tasks of relying on purchasing personnel are the main tasks. Due to the separation of items and information, the material specification data and quantity information imported by the purchaser cannot be confirmed whether it is consistent with the actual product.

B. Intelligent design and process analysis (TO-BE)

RFID technology application equipment includes: RFID UHF Reader and RFID Antenna antenna,RFID UHF Tag, its technical environment equipment configuration description is shown in Figure 4-5

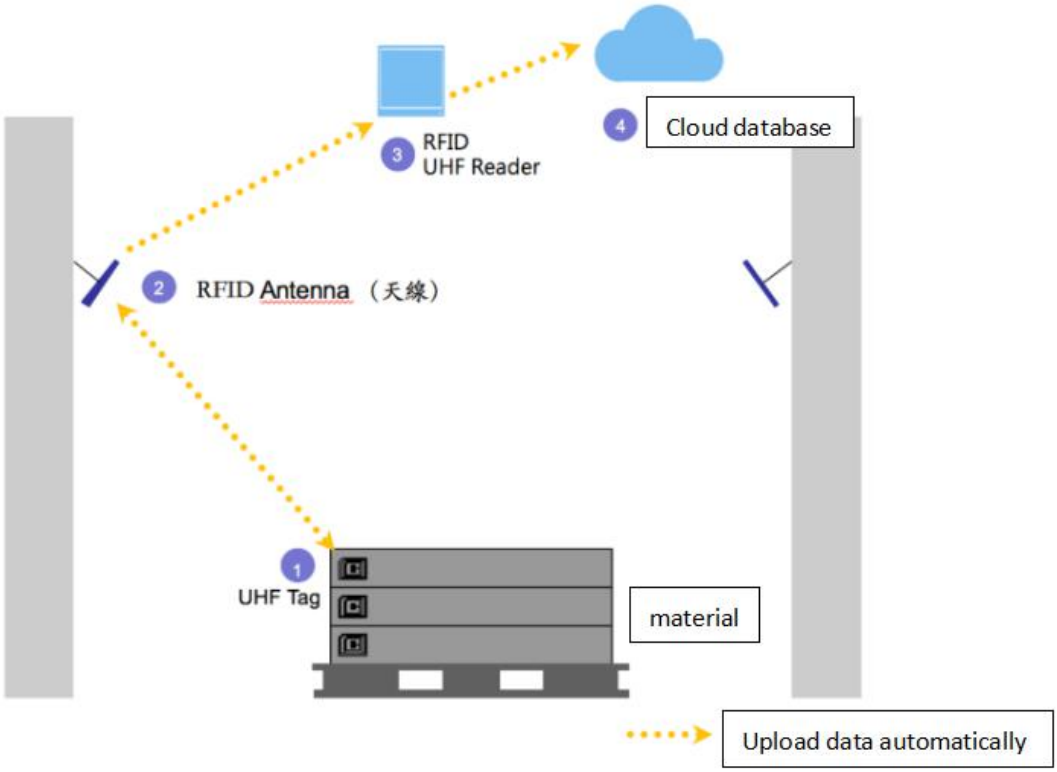

Figure 4-5: Schematic diagram of RFID induction area-material inventory area

The main function of the hardware system:

RFID UHF Reader: RFID UHF TAG reader, using RFID Antenna to read the RFID UHF TAG on the outer box of the material

Intelligent process design includes: material entry automation, process card control management, and logistics intelligence

(1)**Material entry automation:** materials are dispatched by warehouse management personnel to the raw material warehouse of the manufacturing department for warehousing operation arrangements and distribution. The material operators in the manufacturing department check that the quantity of incoming materials and the quantity of the requisition issued by the purchaser are consistent,

confirm that the material items and quantities are correct, and after the appearance inspection of the goods, the materials are transported through the RFID material sensing area (Figure 4-6) , RFID UHF Reader and RFID Antenna antenna, the sensing device will automatically collect the RFID UHF signal on the material, and return the incoming data to the cloud database for material number and quantity comparison, and the material will be automatically completed after confirmation by the material operator in the manufacturing department System accounting operation.

Figure 4-6: Schematic diagram of RFID technology application-plan view of material inventory area

(2)**Process card control managemen**t: Establish a massive data database (COASystem) (database of material measurement values) for measuring qualified products by incoming manufacturers and engineering units instead of manual importing. When the RFID sensing device collects the RFID UHF TAG on the signal material At the same time, immediately after

the cloud comparison and analysis, the unauthorized batch number materials can be prevented from flowing into the factory in the first time. This action takes advantage of the pre-operation of intelligent management of defective product card control. The time cost of personnel comparison, manual check and manual operation is improved. This complete database provides the inconvenient manual operations for special product picking in the past to make it easy to find materials quickly and easily.

(3)**Intelligent logistics**: The logistics process is automatically compared through the interconnection of the system. The purchaser's incoming demand list on the day, the required quantity and the RFID actual received quantity are checked. When the accounting is unbalanced, it can be self-checked regardless of the operating end or the management end. The management platform received abnormal feedback. Incoming notifications that rely on personnel to report back, and the system actively reports back.

C. RFID import benefit analysis:

The use of RFID sensing devices through the Internet of Things, system and system interconnection communication, can simultaneously achieve the series of information such as people, machines, materials, and the benefits:

(1)The system automatically confirms materials and reports information,

replacing the past operation method that relied on personnel to report back.

(2)RFID UHF Reader, RFID Antenna antenna, and sensing device replace the heavy work hours of wireless barcode machines to scan one-dimensional barcodes of physical materials.

(3)RFID sensing device and system interconnection can automatically complete material warehousing and purchase quantity verification, and establish real-time inventory status.

(4)RFID system interconnects the measured value data database of materials to assist in the control of defective materials, handling of special conditions and abnormal feedback.

Table 4-1: Material storage area, intelligent pre/post operation mode-benefit table

project	There is operation mode (front)	Smart design mode (post)
Inbound operations	Manually scan the one-dimensional bar code on the material through the wireless bar code machine to carry out the storage operation	The RFID sensing device reads the items in the sensing area and automatically completes the warehousing operation Industry, personnel only need to confirm the system
Material operations	(1) Picking and warehousing operations are delivered by manual picking lists (2) Incoming notification that relies on personnel's active return (3) Material inventory data, take regular inventory once a day, and have inventory time poor information gap	(1) Interconnected system delivery and picking schedule (2) RFID automatically updates the status to report the inbound status (3) RFID automatically updates and maintains real-time material status, no time difference

		(4) Build a complete database, provide special product picking
Process card control	none	When the RFID sensing device collects the RFID UHF TAG signal on the material, the card controls the defective product to flow into the factory immediately after the cloud comparison and analysis

Table 4-2: Material inventory area, intelligent pre/post operation mode-man-hour demand analysis table (time unit: second (calculated by averaging the total number of transactions during the test period)

Material inventory area	Operating time (average/second)			Form assignment		
Process	Before import	After import	difference	Before import	After import	difference
Inbound operations	2,898	1,830	1,068	Pick list	Pick list	
inventory check	1,194	0	1,194	Inventory list	none	Material Management System
Total working hours	4,092	1,830	2,262			

4.2.2 Production picking Production picking area

A. Pre-existing operation mode analysis (AS-IS)

The operation process includes: material requisition, material preparation, and factory material requisition

(1)**Requisition application:** In order to maintain production efficiency, the production line will store the basic inventory or safety stock material in the production line to facilitate the operation and use it immediately. Therefore, when the production line inventory is insufficient or the

safety inventory is lower than the standard, the production line operator A material requisition will be submitted to the "material inventory area" the day before through the material management system.

(2)**Material preparation:** After the material operators in the manufacturing department receive the requisition request form of the production plant, they will optimize the outbound order according to the arrival date of the current inventory. To prevent the material inventory from being too long, causing abnormal conditions such as material deterioration, the procedure is completed The material operators in the post-manufacturing department confirm the material items, scan the one-dimensional barcodes of the physical materials one by one through the wireless barcode machine, compare the items, material numbers, and quantities, and place them in the waiting area of the "production requisition area"

(3)**Factory material picking:** After the material operators of the manufacturing department have prepared the requested materials, they notify the factory production line personnel to sign for receipt and receive the materials in the "production picking area". After receiving the notification, the production operator will confirm the item, material number, and quantity of the material in the waiting area of the "production requisition area", and then return the material to the waiting shelf of the "material measurement area" of the factory. The

production operator of the imported material will paste the serial identification number sticker on the designated place of the material. This identification sticker is mainly used to assist the production operator in the use of the material.

From the above operation description, the existing problems in the "material inventory area" operation can be summarized and explained as follows

(1)The material requisition adopts the traditional telephone notification method of personnel. When the production line operator is notified but does not carry out the general operation, the materials will remain in the requisition area.

(2)When the production line operators apply for the quantity of materials, there is no standard calculation specification. The quantity of applications depends on the particularity of the operation and the judgment of the management personnel, which leads to blind spots in inventory management.

(3)First-in, first-out operations are handled manually, which is time-consuming, labor-intensive, and classified operations.

(4)When certain products need to be matched with materials with special standard values, the current operating mode cannot meet the operating method of receiving products with specific specifications, and the materials must be classified separately by manual methods.

B. Intelligent design and process analysis (TO-BE)

RFID technology application and auxiliary equipment include: desktop RFID HF reader, RFID HF TAG, barcode printer, the technical environment equipment configuration description is shown in Figure 4-7

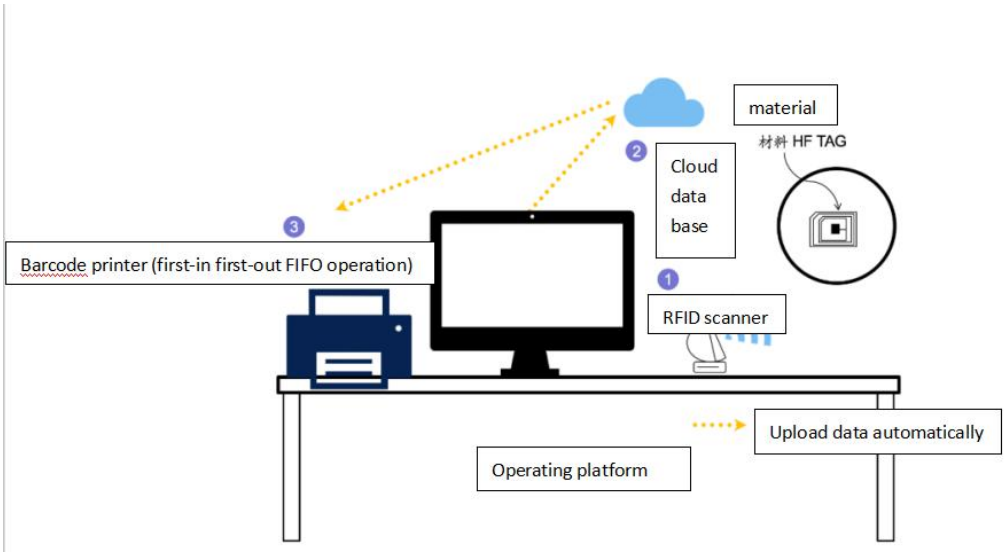

Figure 4-7: Schematic diagram of RFID technology application-production picking area

The main function of the hardware system:

(1)Desktop RFID scanner: read the RFID HF TAG on the material

(2)RFID HF TAG: RFID HF TAG on the material

(3)Barcode printer: the use of a sticker to print the serial number of the material

Intelligent process design includes: production forecast and material preparation, logistics intelligence, process card control management

Production forecast material preparation: RFID HUF Reader sensing

device automatically reads the inventory status of "material inventory area" and "material measurement area", maintains real-time material inventory status, and transmits the back-end cloud database for intelligent data analysis platform Scheduling system, the scheduling system automatically schedules requisitions according to the scheduling requirements of the production line, and can also manage the requisition of specific specifications, and the requisitions are automatically sent back to the "production requisition area" for requisition and release requirements.

Intelligent logistics: The scheduling system automatically schedules picking applications according to the production requirements of the production line, and automatically performs first-in-first-out sorting. When the material operators in the manufacturing department leave the warehouse, the barcode printer automatically generates serial number marking stickers. The first-in first-out operation (materials are used sequentially according to the date of manufacture) is that the RFIDHUF Reader sensing device automatically reads the inventory status of the "material inventory area", and compares the time with the inbound database of the "material inventory area" in the cloud database. First-in-first-out sorting.

Process card control management: RFID Reader automatically updates the status of the material "material inventory area" to "production

picking area" when the material operators of the manufacturing department perform the outbound operation, and at the same time monitors the picking time, and returns the information to the management platform and production line Managers and purchasers can instantly grasp the material dynamics and processing progress, preventing the material from being stranded and unclaimed.

C RFID import benefit analysis

The use of RFID sensing devices through the Internet of Things, system and system interconnection communication, can achieve the series of information such as people, machines, materials, etc. at the same time, resulting in benefits.

(1)According to the scheduling requirements of the production line, the scheduling system automatically schedules material requisition and specific specification product requisition management, and automatically returns to the "production requisition area" for material requisition and issuance requirements.

(2)Automatic material first-in-first-out sorting, and barcode printer automatically generates serial number labeling stickers.

(3)Automatic monitoring of picking time, production line managers and purchasers can grasp the material dynamics in real time, preventing materials from being stranded and unclaimed.

Table 4-3: Production picking area, intelligent pre/post operation

mode-benefit table

project	There is operation mode (front)	Smart design mode (post)
Production forecast preparation	(1) Manual trial calculation, manual material picking application (2) No standard calculation specifications	(1) Automatically scheduled picking application (2) Automated trial calculation and management of specific specifications
First-in first-out automation	Manual work	Automated first-in first-out sorting
Process card control management	No one picks up the materials	

Table 4-4: Production requisition area, intelligent pre/post operation mode-man-hour demand analysis table (time unit: second)

(Calculated by averaging the total number of transactions during the test period)

Production picking area	Operating time (average/second)			Form assignment		
Process	Before import	After import	difference	Before import	After import	difference
Scheduled material calculation	522	180	342	none	none	Scheduling system
First-in first-out automation	348	0	348	First-in first-out record table	none	First-in first-out management system
Process card control management	457	0	457	none	none	Production management system
Total working hours	1,327	180	1,147			

4.2.3 Material measurement Material measurement area

A. Pre-existing operation mode analysis (AS-IS)

The operation process includes: scheduled material preparation, material quality measurement, and form recording operations.Schedule material preparation: According to the production schedule in the next 12 hours, the foreman informs the production line operator to prepare for material preparation. After the operator receives the notification, he will first perform a trial calculation of material use based on the stock of the "feeding storage area", such as " In the event that the material inventory in the “material storage area” is insufficient for production, the operator will go to the shelf of the “material measurement area” to pick up new materials for preparation, so as to facilitate future production and input requirements. When receiving materials, according to the production conditions, different specifications of designated materials are required. The operator must confirm the correct material items one by one, and then use the materials in order according to the expiration date. The process operators use the form to query and record.

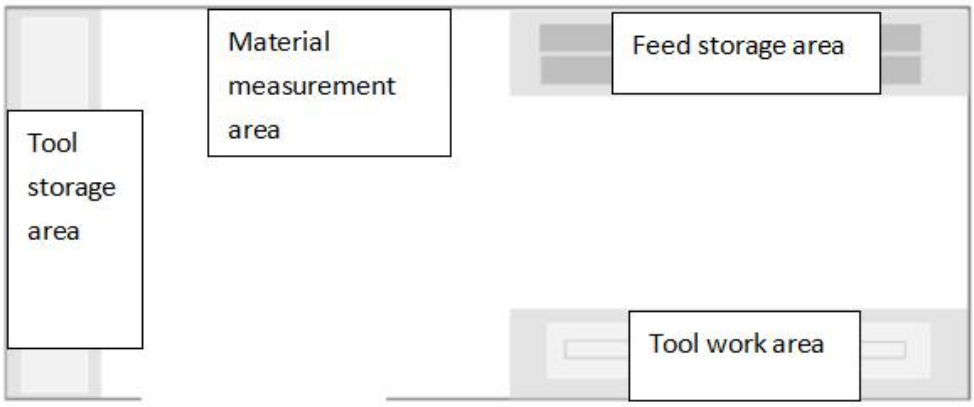

Figure 4-8: Schematic diagram of material measurement area

Material quality measurement: The quality of the process material will affect the product yield quality. To ensure the quality of the product in production, the material needs to be measured before being put into production. Operators measure material-related quality data to ensure process stability and avoid abnormal product yield caused by the quality of poor materials. Data recording during the measurement process, use the job sheet to record the inspection and measurement data on the form one by one.

Form recording operation: For material use, the operator must use the form to record the use process; to measure the program value, the operator must record the measurement data of the inspection items on the form one by one.

From the above description, the existing problems in the operation of the existing "material measurement area" can be summarized and explained as follows:

(1)The quantity of materials required for production scheduling depends on personnel trial calculations and empirical judgments. This procedure is quite time-consuming.

(2)The use of materials and the confirmation of information must be confirmed based on the data recorded in the form.

(3)Material information relies on paper forms, and managers cannot

know the status of production preparations in real time.

(4)Measurement data is a very important material data in the production and manufacturing. It adopts the text records of traditional forms, which cannot be analyzed in real time, and it effectively assists in preventing abnormal production.

(5)When an abnormal problem needs to be tracked, the existing method can only confirm and track back one by one, which consumes a lot of manpower and material resources, and cannot be tracked immediately when the abnormality occurs.

B. Intelligent design and process analysis (TO-BE)

RFID technology application and auxiliary equipment include: RFID management terminal, RFID HF sensing device,RFID HF TAG,handheld RFID HF reader, HID identification card, tablet computer, its technical environment equipment configuration description is shown in Figure 4-9

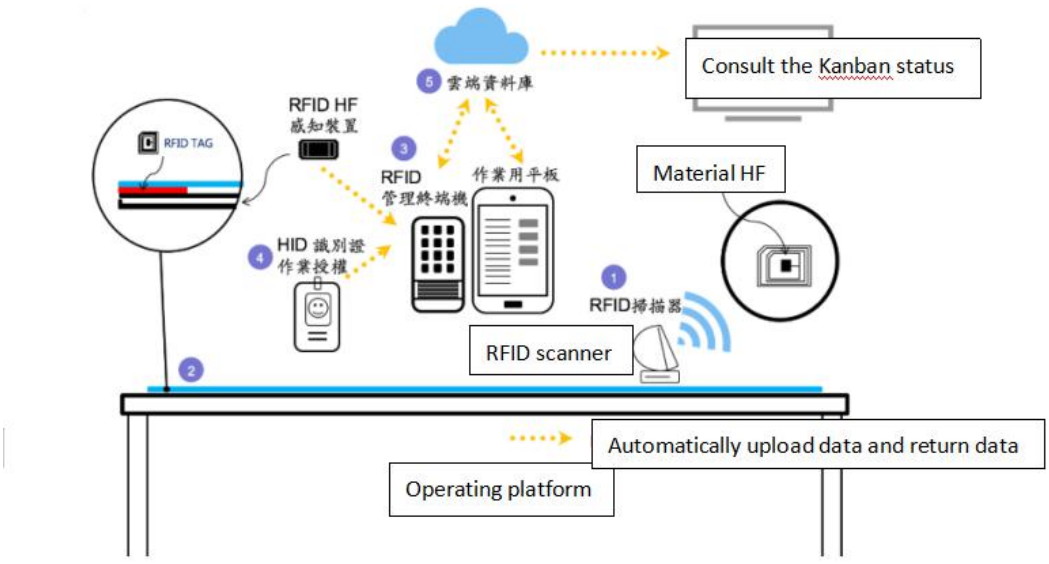

Figure 4-9: Schematic diagram of RFID technology application-material measurement area

The main function of the hardware system:

(1)RFID management terminal: 1. Process the RFID HF TAG signal returned by the RFID HF sensing device 2.Personnel authority control and process logic judgment 3. Internet of things information and cloud database exchange.

(2)RFID HF sensing device: read RFID HF TAG signal and send it back to RFID management terminal.

(3)RFID HF TAG: RFID HF TAG on the material

(4)Desktop RFID scanner: read the RFID HF TAG on the material

(5)Tablet PC: digital input operation interface

Intelligent process design includes: material scheduling automation, data informationization, automatic update of material status, process card control management

Material scheduling automation: After intelligentization, the system logistics can use RFID to grasp the quantity of "material measurement area", which can be used for the scheduling calculation of the production platform to update the material preparation demand status in the next twelve hours in real time, without the need for managers to issue material preparation notifications , The system provides a material requirement table for automated scheduling by production line

personnel (Figure 4-10), and the system can respond to changes in production scheduling immediately and update the material requirement table at any time. The first-in, first-out management of materials is changed from the visual way of personnel to the system optimization sequence. The personnel use materials according to the specifications, which prevents the problem of material deadlines.

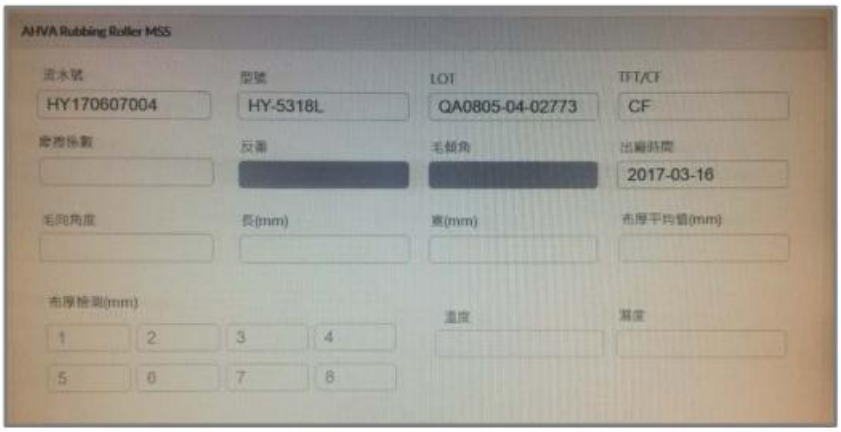

Figure 4-10: Automatic scheduling and production material status diagram

Data informationization: In order to achieve the purpose of intelligent information exchange in the Internet of Things, the measurement data is input through the tablet device (Figure 4-11) and the measurement data is transmitted to the cloud database to achieve the benefits of data real-time, production history collection and data analysis. Instead of manual form operations, manual filtering of statistical data.

Figure4-11: Data Informationization

Automatic update of material status: After reading the material HF TAG with a handheld RFID reader, when the material is placed on the work platform, when the RFID HF sensing device detects the RFID HF32TAG on the material carrier, the material will be automatically processed The data relevance is determined, and it is transmitted back to the cloud database through the RFID management terminal, and the material status is established in the system and interconnected and communicated with the related system, which can simultaneously achieve the connection of human, machine, material and other information. The material status is automatically updated, reducing the process efficiency of personnel operations, and can effectively increase the timeliness of personnel operations.

Process card control management: After the tablet digital input replaces the manual form operation, the digital interface can simultaneously identify the operator's identity, and use the RFID management terminal

to collect and cooperate with the HID identification card worn by the staff to perform identity recognition to achieve identity confirmation , Permission control, and the benefits of data.

C. RFID import benefit analysis

The use of RFID sensing devices through the Internet of Things, system and system interconnection communication, can achieve the series of information such as people, machines, materials, etc. at the same time, resulting in benefits:

(1)The RFID sensing device allows the system logistics to grasp the quantity of materials in the "material measurement area" for the production platform to schedule calculations, and to update the preparation requirements and status in real time. It does not require management personnel to issue a notification of preparations, and provides a material demand table for automated scheduling by production line personnel.

(2)The first-in-first-out management of materials is changed from the visual way of personnel to the optimization of the system. The materials used by personnel are standardized and follow the norms, which prevents the problem of material deadlines and saves manpower and man-hours.

(3)Before the materials are put into production and use, the quality of the materials needs to be measured by the operators. The relevant

material data is input through digitization, instead of the traditional manual form writing paper method. The advantage of data input can be data comparison and logical inspection at the same time.

(4)The quality database is automatically collected during operation, and the back-end engineers can grasp the quality data for analysis and mining in real time, and the database report information is available for analysts to track.

(5)Due to the interconnection and communication of the system, the management platform can update the production conditions according to product restrictions, to achieve the advantage of real-time correction, and to change the restrictive logic in real time.

(6)With the real-time update feature of RFID, personnel can understand the material status and visual management on the job site through the real-time information board, and achieve the synchronization of on-site dynamics and material status information.

Table 4-5: Material measurement area, intelligent pre/post operation mode-benefit table

Project	There is operation mode (front)	Smart design mode (post)
Schedule material preparation	(1) The foreman tentatively calculates the production schedule for the next twelve hours, and informs the production line operators to prepare for material preparation (2) When receiving materials, the operator must confirm that the material items are correct one by one,	(1) RFID compares the existing inventory status, and the production platform automatically calculates the demand schedule quantity, without the need for management personnel to issue a material preparation

	and then use the materials in order according to the expiration date. (3) Operators use forms to query and record during operation	notice. (2) The system judges the material items according to the schedule, and controls the material deadline according to the optimized sorting of the cloud data system (3) The interconnection and communication of the system no longer rely on forms
Material quality measurement	(1) Work records are filled in by manual forms (2) Exception tracking query form records one by one	(1) Digital input method, and can compare data and logic check (2) Digital input has established a measured value database, which can be directly inquired by the platform
Form record job	Fill in manually	Digital input
Automatic update of material status	Any material status changes need to be recorded by personnel	Automatically return updated data by the RFID sensing device
Process card control management	No card control process design	The RFID management terminal adopts the HID identification card for identity induction recognition

Table 4-6: Material measurement area, intelligent pre/post operation mode-man-hour demand analysis table (time unit: second) (calculated by averaging the total number of items during the test period)

Material measurement area	Operating time (average/second)			Form assignment		
Process	Before import	After import	difference	Before import	After import	difference
Scheduled material calculation	828	276	552	none	none	Scheduling system
Material and first-in first-out confirmation	162	0	162	First-in first-out	none	First-in first-out management

				record table		system
Material status update	186	0	186	Inventory status table	none	Production management system
Measurement job	774	550	224	Product Measurement Record Sheet	none	Measurement data information system
Total working hours	1,950	826	1,124			

4.2.4 Feeding storage area

A. Analysis of existing operating mode (AS-IS)

The operation process includes: material storage, material management, inventory operation, exception management, and form operation.

Material storage: The material is a cloth-like material made by precision technology. Due to the consistent appearance and cannot be marked on the material, the material identification management is currently based on the attachment form. After the materials have passed the measurement and inspection, the materials will be stored on the rack in the "feeding storage area" together with the record sheet for the operation, and the material item will be identified by the sheet and the material number identification plate on the rack. The material and the form cannot be separated because detailed material information and measurement data are recorded on the form, and the material will be stored on the rack in this area until the material is officially produced in the "fixture operation area" of the next process.

Material management: The appearance of the materials is the same,

and the measured values of each piece of material are of different quality, and the material differences cannot be recognized by the naked eye. The manual form records are used throughout the operation and the information on the form is updated to manage the materials and identify the uniqueness of the materials. In order to control and prevent the quality of the material from changing doubts, the material should not be placed in a constant temperature for more than the specified hours. The entire operation process uses the form record control for time control, and passive personnel check.

Inventory operation: The operator counts the materials one by one according to the materials on the rack and the material identification card, and conducts manual counting of the quantity.

Abnormality management: There is no anomaly control reaction mechanism, relying on the abnormal feedback of the post process.

Form operation: the material storage process must be recorded by the operator using the form; the process record of the material use, the operator must use the form to record and update the information on the form.

According to the above operation description, the existing problems in the operation of the existing "feeding storage area" can be summarized and explained as follows:

(1)Use form operations, rely on manual operations throughout the process, record and update the information on the form to manage materials and identify the uniqueness of their materials.

(2)Manually write human errors and omissions

(3)The material and the form cannot be separated, otherwise it will cause problems in material identification.

(4)To prevent the quality of materials from becoming doubtful, passive personnel control methods cannot ensure that personnel can use materials based on the length of material inventory.

(5)There is no abnormal control and reaction mechanism, and the occurrence of abnormalities can only rely on the abnormal feedback after the process.

(6)When the quality of the material is abnormal, the material is HOLD (temporarily stop using it if there is doubt about the material), and the reaction time is long, and the manual form can only be checked one by one, and the material is taken out and sent to the abnormal area for processing.

(7)Management of the innumerable digitized information platform for materials, if you need all the material conditions and status of the "feeding storage area", you need to review the form one by one

(8)Since the material cannot be visually identified, and the material cannot be marked with text, unauthorized human changes will cause

serious variables and high potential risks.

B.Intelligent design and process analysis (TO-BE)

RFID technology application and auxiliary equipment include: RFID management terminal, RFID HF sensing device,RFID HF TAG, HID identification card, IOT alarm, the technical environment equipment configuration description is shown in Figure 4-12.

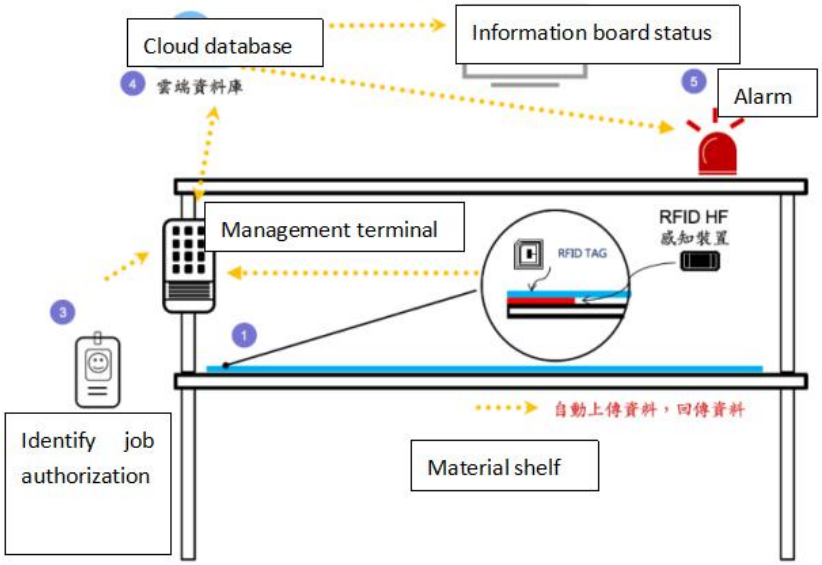

Figure 4-12: Schematic diagram of RFID technology application-feeding and storage area

The main function of the hardware system

(1)RFID management terminal:

1. Process the RFID HF TAG signal returned by the RFID HF sensing device

2. Personnel authority control and process logic judgment

3. Exchange of Internet of Things information and cloud database

(2)RFID HF sensing device: read RFID HF TAG signal and send it back to RFID management terminal.

(3)RFID HF TAG: Attached to the material RFID TAG

(4)IOT alarm: bound with RFID equipment, it will sound an alarm after receiving the trigger signal of abnormal equipment.

Intelligent process design includes: automatic update of material status, process card control management, authorization management

Automatic update of the material status: After the material passes the measurement and inspection, the material will be stored on the shelf position of the material rack in the "feeding storage area". When the material is placed on the unloading rack, the RFID HF sensing device on the rack will automatically sense the HF TAG of the material, and the information will be returned to the RFID management terminal. The RFID management terminal will automatically upload the cloud and update the material status and dynamics and inventory information in real time. And after being intelligent, there is no need to use the form to record.

Process card control management:

(1)Since the appearance of the materials is the same, the measured values are different, and the difference in the materials cannot be visually recognized. If the material rack in the "feeding storage area" is unclearly changed, the potential risk is quite high. Manage the terminal and RFID HF sensing device, automatically sense the HF TAG status of the materials on the shelf and perform abnormal monitoring. Any

unauthorized movement will automatically trigger the IOT alarm to provide immediate prevention and treatment, which can effectively prevent unknown changes. After being intelligent, there is no need to use form records

(2)Collect signals by RFID HF sensing device to achieve material status and material dynamic automation update.New, and link to the measurement database of the "Material Measurement Area" to achieve the integration of information between the system and the system, which can improve the abnormal tracking operation. You can only review the form one by one, and the abnormality can only rely on the feedback of the post-process abnormality the way.

Authorization management: use RFID management terminal, RFID HF sensing device, HID identification card, IOT warning equipment for authority control, in the process, it can be connected to the cloud database and system to achieve the serial connection of information at the same time, and the back-end management platform controls and Authorized qualified operators, operators use HID identification card induction RFID management terminal for identity confirmation, if authorized personnel can use materials, if unauthorized personnel, the interconnected system will trigger the IOT warning device and notify the management platform (Figure 4 -13)

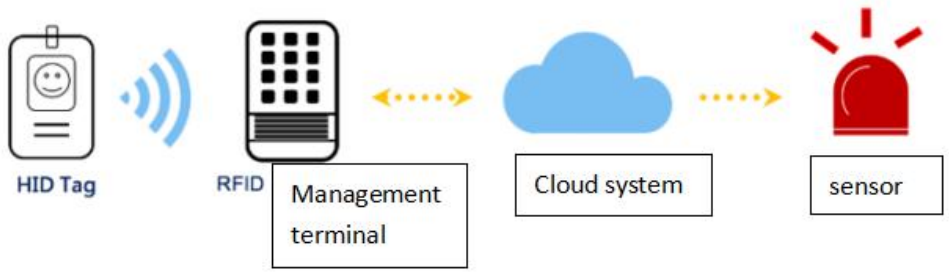

Figure 4-13: Application of RFID authorization management technology

C.RFID import benefit analysis

The use of RFID sensing devices through the Internet of Things, system and system interconnection communication, can achieve the series of information such as people, machines, materials at the same time, resulting in benefits.

(1)Exception handling response is fast, no need to review through manual forms.

(2)It is no longer necessary to use the traditional form operation method and record, and the manual form status record is replaced by RFID automatic sensing.

(3)RFID can track the length of material inventory, and schedule and dispatch the materials according to the manufacturing date to prevent the quality of the materials from changing doubts.

(4)Management and authorized personnel authorize the use of materials to prevent unauthorized changes from causing serious variables.

(5)RFID material status and material dynamic automatic update,

personnel use real-time information platform to grasp the material status and inventory quantity.

(6)The Internet of Things information exchange achieves the integration of the system and the system, collects the information of the whole area to the management platform for the management personnel to obtain the production information and the information status to view the version, to achieve a smart site.

Table 4-7: Feeding storage area, intelligent pre/post operation mode-benefit table

project	There is operation mode (front)	Smart design mode (post)
Automatic status update	Material status changes need to be recorded by personnel	Automatically return data and update dynamics by the RFID sensing device
Process card control management	(1) Design of cardless access control process (2) No abnormal control response mechanism	(1) Unauthorized movement will automatically trigger the IOT alarm, providing immediate prevention and treatment (2) The RFID sensing device automatically controls abnormal goods according to conditions to prevent abnormal goods from flowing to the next process
Authorization management	none	The RFID management terminal adopts the HID identification card for identity induction recognition

Table 4-8: Feeding storage area, intelligent pre/post operation mode-man-hour demand analysis table (time unit: second) (calculated

by averaging the total number of transactions during the test period)

Feeding storage area	Operating time (average/second)			Form assignment		
Process	Before import	After import	difference	Before import	After import	difference
Form assignment	106	0	106	Drying work record sheet	none	Production management system
Material confirmation	370	96	274	Drying work record sheet	none	Production management system Rights Management System
Total working hours	476	96	380			

4.2.5 Fixture operation Fixture operation area

A. Pre-existing operation mode analysis (AS-IS)

The operation process includes: preparation of materials, machine operations, and form recording operations.

Preparation of materials: Before the materials are officially used on the machine, the materials need to be attached to the machine fixture to facilitate the use of the machine. According to the production schedule within eight hours, the foreman informs the production line staff to prepare the fixture, and the production line staff uses the materials according to the production instructions and takes the materials needed for production from the "feeding storage area". The materials must be confirmed and followed by the material variety The manufacturing date

and time are taken one after the other. This confirmation step is to manually pick up the materials after the form data is judged, and the form information needs to be updated synchronously.

Machine operation: The machine operation process includes confirming production instructions, confirming material types and fixtures, material pasting operations, and updating form information.

(1)The production line workers attach the material to the jig of the machine through the operation of the machine. When operating the jig, the personnel must confirm that the material is in accordance with the type and the direction of the jig is correct. Different jig specifications have different directional behaviors. Every core operation and action are manually judged, and the form information needs to be updated synchronously after the operation.

(2)When the machine is operating, the material is placed on the work platform, and the jig will be lowered to the platform to roll through the machine. With the balanced rolling power of the machine, the pre-adhesive glue on the jig will make the material flat.

Form record operation: The process record of material use, the production line operator must use the form to record and update the information on the form. The process record of the machine fixture operation, the operator must use the form to record.

From the above description, the existing problems in the operation of the existing "fixture operating area" can be summarized and explained as follows:

(1)The production materials of the day depend on the production line foreman to confirm, and the production schedule changes are often not as good as immediate response.

(2)The materials must be picked up according to the manufacturing date and time. This step is determined by manual judgment and cannot be confirmed whether it meets the first-in first-out picking and compliance standards.

(3)When the machine is operated, the direction of the fixture is different due to the different specifications, which are all manual operation judgments, and it is impossible to ensure that the operator will not misjudge the direction.

(4)The entire production operation relies on manual forms for operations, and manual writing of human error or missing information.

(5)The machine and material information has not yet been digitized, so it is not possible to provide real-time tracking and control.

B Intelligent design and process analysis (TO-BE)

RFID technology application and auxiliary equipment include: RFID management terminal, RFID HF sensing device, RFID HF TAG, RFID UHF Reader, UHF TAG, IOT alarm, HID identification card, tablet computer.

The technical environment equipment configuration description is shown in Figure 4- 14

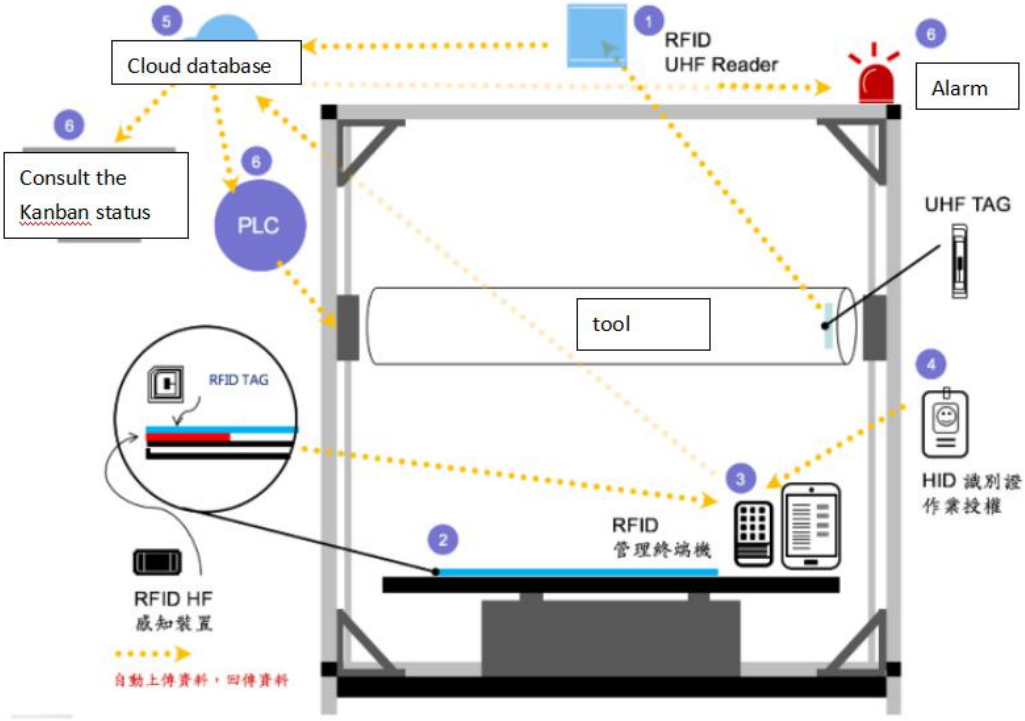

Figure 4-14: Schematic diagram of RFID technology application-jig work area

The main function of the hardware system：

(1)RFID management terminal:

1. Process the RFID HF TAG signal returned by the RFID HF sensing device

2. Personnel authority control and process logic judgment

3. Exchange of Internet of Things information and cloud database

(2)RFID HF sensing device: read RFID HF TAG signal and send it back to RFID management terminal

(3)RFID HF TAG: Attached to the material RFID TAG

(4)RFID UHF Reader: RFID UHF TAG reader, using RFID antenna to read

the fixture RFID UHF TAG

(5)RFID UHF TAG: RFID TAG attached to the fixture

(6)IOT alarm: bound with RFID equipment, it will sound an alarm after receiving the trigger signal of abnormal equipment.

(7)Tablet PC: Digital input operation interface

Intelligent process design includes: material scheduling automation, material status automatic update, process card control management, data informationization

Material scheduling automation: The production platform performs calculations based on the eight-hour production schedule and the existing material inventory in the "feeding storage area". The source of the inventory is the real-time inventory value automatically uploaded to the cloud by the RFID sensing device. The intelligent system is real-time Update material requirements and status, and can respond to production schedule changes in time, and update the real-time material requirements table at any time (Figure 4-15)

1. Automatically scheduled material requirements table, optimized date sorting by the system, so that the materials used have time to comply with the specifications, and prevent the problem of material deterioration and deadlines

2. The material requirement table generated by the system will be sent

by the system after the management personnel approve the material preparation notice, and the production line personnel will be provided with material preparation preparation

Figure 4-15: Material scheduling automation dispatch and material status update

Automatic update of material status: (Figure 4-15) Two sets of RFID Reader devices are designed on the machine, which are the passive RFID HF Reader on the work platform and the passive RFID UHF Reader on the machine.

1. **Operating platform Passive operating platform Passive RFID HF Reader:** When the material is placed on the operating platform, the platform RFID sensing device will automatically sense the material HF TAG, and send it back to the RFID management terminal to automatically upload the cloud, and retrieve the material information to the tablet of the operating platform On the interface, the system automatically updates the material status from the "material measurement area" to

the "fixture work area". The manual form records of the existing operations are intelligentized by the perception status of the RFID Reader and the back-end system update status.

2. **Machine Passive Machine Passive RFID UHF Reader:** After the system information platform senses the RFID HF material signal, the RFID UHF Reader will automatically sense the fixture UHF TAG, and automatically upload the cloud to retrieve the fixture information to the interface on the operating platform. The above two sets of RFID Reader signal information are automatically uploaded to the cloud, and the RFID HF TAG ID and RFID UHF TAG are bound to the data, and then the information is returned from the back-end cloud database. The production line operators can instantly understand the material status and fixtures through the flat computer Information, updated and operated simultaneously on the interface.

Process card control management: Through the operating platform RFID Reader and the machine RFID Reader, the sensing information of the two is automatically uploaded to the cloud and the back-end database data is retrieved, and the information is returned in real time to understand the material status, fixture information, and Production schedule.

1. Different specifications of production jigs and attachments will have different directionality. After intelligentization, the RFID UHF Reader can use the sensing position to judge the directionality, and compare it with

the HF Reader sensing position data of the operating platform in the back-end system. Yes, automatically check the correctness of the direction.

2. When an abnormal error occurs, the interconnected system will trigger the IOT warning device, and the PLC (Programmable Logic Controller) of the machine will be linked to limit the movement of the machine. During the process, the system will communicate with the production line personnel through the tablet computer.

3. The operator uses the HID identification card to induce the RFID management terminal to confirm the identity. If the authorized person is designated, the machine can use the material, and if the unauthorized person is the interconnected system will be touch the IOT warning device and notify the management platform

Data informationization: Use digital interface to update and operate and synchronize information, instead of manual form operations, to achieve information connection in various regions, data can be real-time, production history tracking, and data analysis benefits to achieve the purpose of intelligent Internet of things information exchange. Data-information production line operators can obtain material status and jig information in real time. The production history information of the material for the material status includes: the measurement data of the "material measurement area", the standard hour control of the

"feeding storage area", "Management platform" production condition restriction type; fixture information status includes: "management platform" production condition restriction type (machine, direction, product category, etc.)

C. RFID import benefit analysis

The use of RFID sensing devices through the Internet of Things, system and system interconnection communication, can simultaneously achieve the series of information such as people, machines, materials, etc., resulting in benefits

(1)Material scheduling automation can update material requirements and status in real time, and the intelligent system can respond to changes in production scheduling in time, and update the real-time material demand table at any time.

(2)Computerized operation on the machine and linked to the machine PLC

(3)Abnormal situations will sound an alarm after the trigger signal of the IOT alarm is bound to the RFID device.

(4)Digital forms to achieve information connection, data can be real-time, production history tracking, data analysis benefits.

Table 4-11: Machine operating area, intelligent front/rear operation mode-benefit table

project	There is operation mode (front)	Smart design mode (post)
Schedule material preparation	(1)The foreman confirms the production schedule and restrictions within six hours of the day, and releases it for production Instructions (2)Operators use forms to query and record their operations	(1)Material scheduling automation can update material requirements and status in real time (2)Interconnected system communication no longer relies on forms
Process card control management	(1) Manual check to confirm (2) No authorization control (3) No auxiliary system to assist production line operators and judgment	(1) RFID automatically checks the correctness of the fixture direction. If an abnormal error occurs, the interconnected system will actuate the IOT warning device alone to remind the operation to confirm (2) After the operation of the production line operator is confirmed to be correct, the HID identification card is sensed for authorization card control and personnel identification confirmation (3) Work operation and machine PLC linkage (4) Compare the jig information whether the material jig meets the conditions of the machine (5) Compare the material information and whether the machine meets the production instruction conditions
Machine operation	Manual form update	Automatic update of material status

Table 4-12: Machine operating area, intelligent pre/post operation mode-man-hour demand analysis table (time unit: second) (calculated by averaging the total number of transactions during the test period)

Machine operating area	Operating time (average/second)			Form assignment		
Process	Before import	After import	difference	Before import	After import	difference
Scheduled material calculation	876	247	629	none	none	Scheduling system
Form assignment	230	0	230	Open line operation record sheet	none	Production management system
Homework check	887	442	445	Open line operation record sheet	none	Production management system
Total working hours	1,993	652	1,341			

4.2.6 Fixture storage area

A. Pre-existing operation mode analysis (AS-IS)

The operation process includes: jig storage, jig use, form record operation

Fixture storage:

1. When the material is used up, the production line operator will remove the production jig and record the off-shelf information on the form, and then transport the jig back to the jig storage for storage. At

this point, all the operating steps of the material life cycle of this process are completed, and the form is Check

2. When the materials are not used at the end of the process and the unused materials are off the shelf, the production line operators will transport the jig to the jig storage for storage, and wait for the next production schedule to be used again. The form needs to record the number of times the material has been used. , To control the upper limit of material use (the maximum number of times the material is used), and correctly record it on the form for the next pre-production operation query.

Fixture use: When the fixture needs to be used out of the warehouse, the production line operator needs to confirm the form and fixture restriction condition one by one, and after confirming that the conditions meet the production instructions, the fixture is exported to the storage through the machine operation.

Form record operation: the inspection steps and process records related to the removal of the fixture, the production line operators must use the form to record and update the information on the form.

From the above description, the existing problems in the operation of the existing "fixture storage area" can be summarized and explained as follows.

(1)The operator will record the number of times the material has been used on the form to prevent excessive use of the material. However, this task is for the staff to copy the machine information and write on the form. If the staff writes wrongly, it will cause excessive use of the material and cause irreversible and serious losses. The existing operation does not have a system to assist in the correctness of the data.

(2)Information management without data. When there is a need to query information, the production line operator or engineer must use the form to query one by one. There are still materials in the fixture storage that have not been used. This procedure takes a lot of manpower to confirm the man-hour.

(3)There are a lot of jigs in the jig storage, and each jig has different conditions and specifications. There are certain restrictions on production and use. The current operation needs to confirm the number of available jigs through the form information, and it needs to be checked one by one. Query statistics, the operation method is time-consuming and laborious.

B. Intelligent design and process analysis (TO-BE)

RFID technology applications and auxiliary equipment include: RFID UHF Reader, UHF TAG, tablet brain, its technical environment equipment configuration description is shown in Figure 4-17

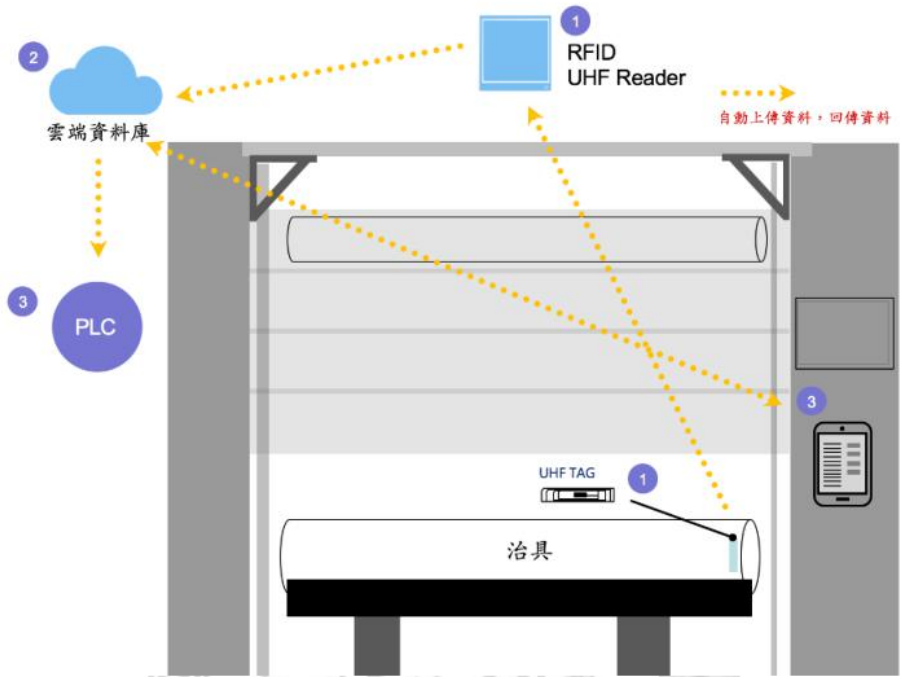

Figure 4-17: Schematic diagram of RFID technology application-fixture storage area

The main function of the hardware system

(1)RFID UHF Reader: Read the RFID UHF TAG on the fixture

(2)RFID UHF TAG: Fixture RFID TAG

(3)Tablet PC: Digital input operation interface

Intelligent process design includes: warehousing operations, jig use, automatic update of material status

Warehousing operation: There are two situations in which jigs are warehousing.

1. **The material is used up**-when the material is exhausted, the jig will be

off the machine. The production line operator pushes the jig to the entrance of the warehouse and prepares to be imported into the machine storage warehousing, and waits for the next "fixture work area" to be used again on the machine. The RFID UHF Reader will automatically sense the RFID UHF TAG on the fixture, and automatically update the fixture status to "Warehouse" in the back-end system. After the personnel confirm the storage location, the machine will import the fixture into the designated storage location and send it back Information to the back-end system.

2. **The unused material**-when the production process is over, the unused material jig will be removed from the machine, and the production line operator will push it to the jig storage entrance and prepare to be imported into the machine storage warehousing. The RFID UHF Reader on the machine automatically senses the treatment. With the RFID UHF TAG, the back-end system updates the status "Warehousing pending machine", and automatically records the return time and material number information in the machine information.

System "Status Status Judgment" The RFID UHF TAG read in by the RFID UHF Reader automatically obtains the "machine operating area" data to achieve real-time and accurate status updates.

Fixture use: Fix the fixture out of the warehouse, use RFID to read the

fixture inventory information in the warehouse, automatically judge and compare fixtures that meet the production conditions and restrictions, and provide the information to the operator through the lithographic device.

Automatic update of material status: RFID UHF Reader automatically senses the RFID UHF TAG on the fixture and updates the status in the back-end system. The automation is as follows:

1. After the materials are used, the UHF TAG data of the fixture will be automatically reset and the production history record will be completed.

2. The status of the fixture is "stocked and ready to be put on the machine" or "empty fixture", and the restricted control is updated by the system's perception.

3. The warehousing and withdrawal are automatically sensed by the RFID UHF Reader, and the inventory status is automatically maintained.

C. RFID import benefit analysis

The use of RFID sensing devices to communicate with the system through the Internet of Things and interconnected systems can simultaneously achieve a series of information such as people, machines, and materials, resulting in benefits.

(1)The system is informatized to grasp the number of existing fixtures that are "in the warehouse and ready to be put on the machine", and personnel can inquire from the information platform, which is not the

way of manual inquiry and counting of the previous operators.

(2)When the jig is released, it can automatically filter and provide the information of the available jigs, and improve the way that the production line operators confirm the form and the jig restriction one by one.

(3)Use RFID UHF Reader to automatically perceive the RFID UHF TAG on the fixture and the serial connection of the "machine operating area" machine information, and the material status can be automatically judged "in the warehouse and wait for the machine" or "empty fixture".

(4)The manual recording operation of the upper limit of material use is automatically interconnected by the system to connect RFID information and machine information to achieve automated and accurate data, instead of manual copying.

(5)There are a lot of jigs in the warehousing, with different conditions and specifications. There are certain restrictions on production and use. RFID automatically senses information and interprets to improve the way that form information must be used to confirm availability in the past.

(6)Achieve digital information and eliminate manual form writing. Production information digitization with real-time, production history tracking, data analysis benefits, etc.

Table 4-13: Fixture storage area, intelligent front/rear operation mode-benefit table

project	There is operation mode (front)	Smart design mode (post)
Inbound operations	The jig warehousing operation is performed manually by viewing the form and filling in "warehousing" and "warehousing to be put on the machine", and no errors should be made during the data filling process	(1)RFID UHF Reader automatically senses and links the string of machine information in the "machine operating area" Connect, read "Warehouse", "Warehouse to be put on the machine" and usage value records (2)RFID UHF Reader automatically senses, and information-based control of the existing "warehousing and waiting to be put on the machine" Number of fixtures
Fixture use	When the fixture needs to be used out of the warehouse, the production line operators need to one by one Second confirmation form and fixture restriction	RFID can be automatically filtered, providing information on available machines and fixtures
Fixture state	Manually use the form to confirm the storage status of the fixture	Automatically sensed by RFID UHF Reader, and the established material status is automatically interpreted
Form assignment	Operators use forms to query and record	Data and status are automatically uploaded and interpreted

Table 4-14: Fixture storage area, intelligent pre/post operation mode-man-hour demand analysis table (time unit: second) (calculated by averaging the total number of items during the test period)

Fixture storage area	Operating time (average/second)			Form assignment Process		
Process	Before import	After import	difference	Before import	After import	difference
Form assignment	108	0	108	Reopening Record Sheet Fixture Work Record Sheet	none	Production management system
Fixture storage	204	65	139	none	none	Production management system
Fixture inventory	468	70	398	Fixture work record sheet	none	Production management system
Total working hours	780	135	645			

4.3 Comprehensive benefit analysis

This research uses RFID radio frequency identification system technology to achieve intelligent material management. Through the application design of RFID HF / UHF passive technology, RFID radio frequency tags are installed on equipment and materials, so that the equipment can identify materials, carriers, and fixtures. Communication link, etc. on the machine PLC and supplemented by business process improvement.

The RFID system introduces "material inventory area", "production picking area", "material measurement area", "feeding storage area", "fixture operation area", "machine operation area", and "fixture storage area" ”And other areas, understand the process materials from warehousing to the end of the process generation life cycle, use RFID

system identification, tracking, monitoring and back-end management during the operation process, through the system and the system to integrate the value-added applications of people, machines, and things. Achieve synchronization and integration, and analyze the benefits of intelligence on the entire process through intelligent manufacturing based on cloud database and big data analysis.

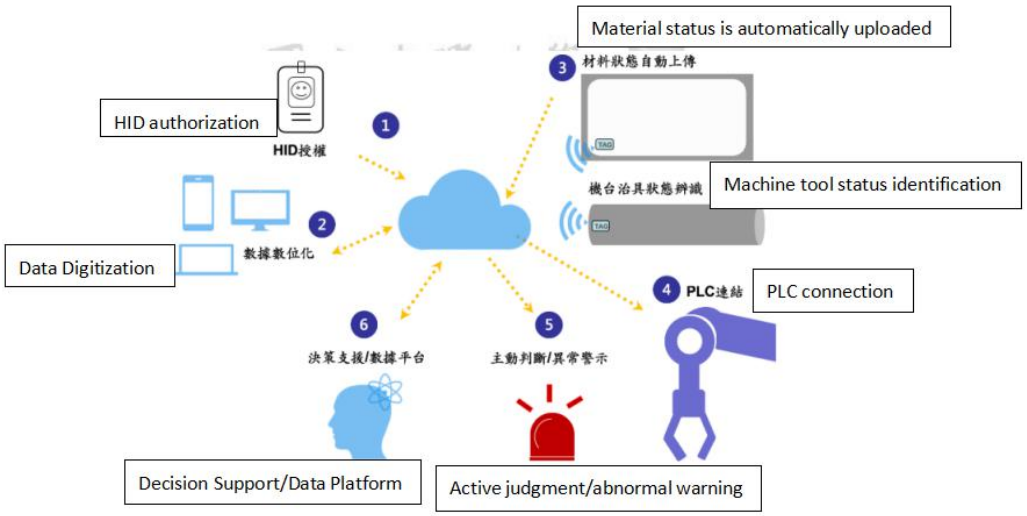

Figure 4-18: Schematic diagram of the establishment of RFID intelligent material management

The comprehensive benefit research analysis is as follows (virtual and actual integration benefits):

Virtual and real integration-to achieve system and system connection and communication, and provide horizontal collaboration and integration among machines, equipment, materials, finished products, and personnel.

Table 4-15: Intelligent Material Management-ISA-95 Information System

Architecture Analysis Table

<table>
<tr><td rowspan="3">Work flow</td><td colspan="6">ISA-95</td></tr>
<tr><td colspan="3">Level 1
Production process sensing and control</td><td>Level 2
Production monitoring and automation control</td><td>Level 3
Manufacturing operation management</td><td>Level 4
Business and logistics operations</td><td>Level 5
Enterprise Operation Management</td></tr>
<tr><td colspan="3"></td><td>surveillance system</td><td>data analysis</td><td></td><td></td></tr>
<tr><td>Material inventory area
Production picking area
Material measurement area
Feeding storage area
Tool work area
Machine operating area
Tool storage area</td><td>RFID</td><td>PLC</td><td>Sensor device</td><td colspan="2">Supplier Material System
Measurement data information system
Material Management System
Manufacturing scheduling system
Production management system
First-in first-out management system
Rights Management System</td><td>Enterprise Resource Planning,ERP
Product Life cycle Management,PLM</td><td>Supply Chain Management,SCM
Customer relationship management,CRM</td></tr>
</table>

The comprehensive benefit research analysis is as follows (obvious benefit, recessive benefit):

4.3.1 Obvious benefits

(1) Reduced manual steps-After the introduction of RFID, many manual steps can be reduced, the man-hours for finding materials, and the time for operation confirmation steps, to achieve the effect of saving staff

time, improving efficiency and reducing operating costs, and reducing the overall benefit evaluation manual operation time by 64.6%. The improvement efficiency pertaining to the logistics process reaches 62.9%; the improvement efficiency pertaining to the production process reaches 66%.

(2) RFID reading tags is fast, accurate, and fully automated. Compared with the traditional method of scanning barcodes, it greatly shortens the labor time of the purchase operation procedure. The improvement rate is up to 55% (logistics operation surface), and the productivity of personnel output is relatively improved.

Table 4-16: Comprehensive Benefit Analysis-Working Hours Demand Analysis Table (Time Unit: Second)

Attributes	Work flow	Operating time (average/second)				
		Before import	After import	difference	Efficiency evaluation	Efficiency evaluation
Logistics operation surface	Material inventory area	4,092	1,830	2,262	55.3%	62.9%
	Production picking area	1,327	180	1,147	86.4%	
Production process	Material measurement area	1,950	826	1,124	57.6%	66.0%
	Feeding storage area	476	96	380	79.8%	
	Fixture operating area	1,284	456	828	64.5%	
	Machine operating area	1,993	689	1,304	65.4%	
	Tool storage area	780	135	645	82.7%	
Total working hours		11,902	4,212	7,690	64.6%	

(3) Reduce personnel judgments-use RFID's timely features and logical message feedback to reduce personnel judgment actions in the process and reduce the number of employees. When manual intervention is reduced, it also reduces the occurrence of human errors and increases the efficiency of operations. The improvement efficiency pertaining to the logistics process reaches 62.6%; the improvement efficiency pertaining to the production process reaches 64.3%, the work hours are reduced, the confirmation time of personnel in the process process is increased, and the efficiency of assisting operations makes the operator become the role of process supervisor. This is also a major spirit of Industry 4.0.

Table 4-17: Comprehensive benefit analysis-analysis table of personnel judgment operation time (excluding scheduling management) (time unit: second)

Work flow	Operating time (average/second)			
	Before import	After import	difference	Efficiency evaluation
Logistics operation surface	4,897	1,830	3,067	62.6%
Production process	4,131	1,475	2,656	64.3%

(4) Scheduling management-the opaque information status will affect the scheduling and scheduling difficult to control, and RFID can automatically obtain the inventory and material status of each area, supplemented by system interconnection decision support, to provide

real-time planning and scheduling in line with the current situation, reducing management personnel, The operation and confirmation actions of the operators in material preparation calculation, commissioning coordination, and the improvement efficiency reached 65.5%~71.8%.

Table 4-18: Comprehensive benefit analysis-schedule management time analysis table (time unit: second)

Work flow	Operating time (average/second)			
	Before import	After import	difference	Efficiency evaluation
Production picking area	522	180	342	65.5%
Material measurement area	828	276	552	66.7%
Tool work area	648	204	444	68.5%
Machine operating area	876	247	629	71.8%

(5) Simplified form operation-90% of the paper forms in the entire site area are built into the system. With RFID automatic information collection and judgment, the staff's work hours in form operations and manual records are reduced by 90%. The introduction of the electronic form system can reduce the staff's form work and input work by 10hr/person/month, and increase productivity by 7% (10hr/150hr/month = 7%)

(6) Information digitization-important data such as important production steps, process parameter settings, operation time, material records and other important data at each stage of the process are recorded on paper forms. The operation is changed to digital input and digital data obtained by RFID automatic sensing, which helps real-time analysis and prevention of production information.

(7) Paperless forms-electronic digitization has the benefit of environmental protection, while saving the troubles and labor costs of form printing and paper recycling and storage operations.

Table 4-19: Comprehensive benefit analysis-the effectiveness of electronic forms

Work flow	Form assignment	
	Before import	After import
Material inventory area	Material picking list, inventory record table	Pick list
Production picking area	First-in first-out record table	Electronic
Material measurement area	Inventory inventory status table, product measurement record table, first-in first-out record table	Electronic
Feeding storage area	Drying work record sheet	Electronic
Tool work area	Tool operation record sheet	Electronic
Machine operating area	Open line operation record sheet	Electronic
Tool storage area	Record sheet for reopening the line, sheet for tearing off the rack, record sheet for jig	Electronic

	operation	
Digitization ratio	0%	90%

(8) Intelligent system assistance-automated production efficiency, simplified personnel system operation interface, and provided personnel with required information instead of a pile of unprocessed data, which was then judged by personnel, combined with mobile flat tools, reducing personnel waiting time by 15%.

(9) Auxiliary exception prevention-to avoid output loss caused by material anomalies, data analysis before the material is put into production can preventively analyze and predict the results to avoid output loss.

(10) Easy to manage special operations-in response to special operations derived from the production process, RFID automated information can provide information systems to directly control operations.

(11) Equipment integration benefit-After the RFID system is compared with the machine, the information is linked with the PLC mechanism, which can prevent error actions and give play to the integration benefits of the RFID system and machine automation equipment.

(12) Production history information-The basic attributes and information of materials during RFID-assisted production can be used correctly and abnormal events can be traced back in the production process.

(13) Data analysis-complete production history information, through

correlation analysis and algorithms, establish a decision support system, predict the possibility of problems during the production process (analysis of the correlation between materials and process parameters, preventive classification of material attributes, and reduce product abnormalities afterwards) Strengthen information prevention and prediction.

(14) Reduce material loss-because the materials, fixtures, and machine equipment status information are independent information entities, the data is opaque, and the coordination is insufficient, resulting in material tearing and scrapping. Intelligentization can reduce the scrap rate of material turnover by 8% a year.

(15) Intelligent logistics-RFID assists personnel in material management and manufacturing processes, assists inventory management, reduces replenishment time, and improves inventory accuracy, etc.

(16) The system in the system-the series connection of the system and the system to realize the integrated value of the product, material and production system, and the life cycle, and to dig out valuable things from the data, it is necessary to connect all the systems to have the core value.

4.3.2 Hidden benefits

(1) The reduction of human operations reduces the number of interference factors, and the digitized information is more accurate, and the accuracy of big data analysis is improved.

(2) Through the correlation analysis of material properties and process parameters, the process knowledge base is established to achieve the effect of abnormal prediction and reduce post-analysis operations and abnormal scrap.

(3) Establish a process decision support system to assist the production process through the process knowledge base.

(4) Prevent personnel misoperations-use wrong materials and use production jigs to prevent a 0.7% misoperation rate per year, and the number of abnormal human misconduct rates is about eight per year.

4.4 Application RFID encountered privacy security problem and solutions in the system

4.4.1Privacy and privacy threats in RFID systems

(1)Privacy and RFID privacy threats:From a conceptual point of view, privacy (also called privacy, privacy) refers to the ability of individuals or organizations to hide information about themselves or themselves. Different countries and individuals have different requirements and understandings of privacy. Generally speaking, they have relative The relativity of privacy means that all privacy has different meanings for different people or in different societies.A basic feature of RFID is the automatic identification of items. Most RFID privacy threats come from uniquely marked tag IDs, which are easy to correspond to human identities. RFID privacy threats mainly include associated threats, preference threats, location threats, action threats, and social Relationship threats and garbage collection threats etc.From a functional point of view, RFID is similar to other traditional automatic identification technologies (such as two-dimensional barcodes). Therefore, RFID itself does not have privacy issues. However, once the RFID tag is associated with a specific target (such as people, goods, etc.), then May bring privacy issues.In short, due to its particularity, RFID technology has a greater risk of privacy leakage, and special methods are needed to

ensure the privacy of RFID technology and various applications based on RFID technology.

(2)RFID privacy classification:From the analysis of RFID privacy threats, according to the different nature of the leaked information, there are two main types of privacy in the RFID application field: information privacy and location privacy. According to the difference of privacy content, it can be divided into information privacy and location privacy.

(a)Information privacy:Information privacy (data privacy) means that the attacker obtains the information in the RFID tag through the RFID reader, and obtains other related information of the individual or organization based on this. According to the privacy violation method, information privacy includes two types-direct information privacy And indirect information privacy.

Direct privacy: Direct information privacy means that the attacker obtains private information directly through the RFID tag. For example, the RFID tag that meets the electronic production code (EPC) standard contains information such as product category. Therefore, the attacker uses RFID After the reader scans the RFID tag on the user, it can directly know the product type corresponding to the tag by analyzing the object category code. Associated threats, preference threats, etc. are all typical direct privacy.

Indirect privacy: Indirect information privacy refers to the in-depth

analysis and reasoning of the product types corresponding to one or more tags, combined with sociology and other knowledge, to summarize, summarize and derive the personal privacy information corresponding to these tags. For example, by analyzing the medicine corresponding to a single RFID tag, the user's disease privacy information can be known, and the attacker can scan multiple RFID tags on the customer through a handheld reader to obtain all the item information held by the customer. Infer the customer's personal preferences or purchasing preferences from this. Threats to social relations and threats of garbage collection are typical indirect privacy.

(b) Location privacy:Location privacy refers to the location or tracking of the target (such as a person or car) corresponding to the tag feature by the attacker by collecting the tag feature of one or more RFID tags. A tag feature refers to one RFID tags are different from other RFID tags quality. The tag feature can be used to uniquely identify the tag. The tag feature can be the unique identifier contained in the RFID tag or the radio frequency physical feature of the tag itself. The unique identifier contained in the RFID tag (such as the 96-bit EPC Code) is the most important tag feature. Because different manufacturers have different definitions of RFID physical air interface, the design, manufacturing and testing process of RFID tags are different, and even the standards adopted are also different, so some special radio frequency signal

characteristics, such as frequency Radio frequency physical characteristics such as transmission modulation, data encoding, etc., can also be used as label features.In addition to tracking the user's single physical location, the attacker may also establish the user's location movement trajectory based on long-term observations, and then infer and predict the user's personal behavior.In order to infringe on location privacy, it is first necessary to establish a mapping relationship between one or more tag features and personal identity. There are many ways to establish this relationship. For example, the establishment of personal RFID by listing personal wearables File, or because of the purchase of a certain sticker.Clothing with RFID tags, and related information is deliberately or unintentionally leaked, etc.According to different methods of infringing privacy, location privacy can be divided into physical location privacy and motion trajectory privacy.

Physical location privacy:Physical location privacy (physic location privacy), also known as location privacy, refers to the deployment of RFID readers in a specific physical area to monitor the RFID tags that appear in the area, identify the target that appears in the monitored area, and obtain the target For example, in the case of knowing a certain RFID tag (such as the RFID tag on a watch), if the attacker wants to know whether the attacked person will appear in a jewelry store, he only needs to use a handheld RFID reader to check The jewelry store is scanned. Similarly, if

the attacker scans the RFID tag around a specific drug in the pharmacy through a handheld RFID reader, it can also identify the potential person who purchased the drug.

Motion track privacy:Moving trace privacy refers to the observation and recording of one or more RFID tags for a period of time to establish their movement history trajectory, and use this to predict their future movement trajectory to obtain private information. The physical location privacy information is different. To obtain the privacy information of the movement track, the RFID tag must be tracked, observed and recorded. Therefore, it may be necessary to set up an RFID reader (or use a mobile RFID reader) in a different physical location to scan the RFID that appears in the range. Labels. For example, if merchants in a shopping mall jointly record the RFID tags that appear in their respective sales areas and exchange information with each other, it is easy to build a model of the customer's trajectory in the shopping mall, thereby inferring the privacy of the customer's personal preferences and other privacy.Generally speaking, infringement of direct information technology is difficult, and because the data is accurate, it is more harmful. Indirect privacy is difficult to guarantee because of the content of reasoning and comprehensive analysis, and the harm is less. Physical location privacy needs to be specified in the physical location. Deploying multiple RFID readers in the area or relying on handheld readers is costly and

technically difficult. However, because the privacy of physical locations may involve many sensitive content of users, it is more harmful. The privacy of motion trajectories must be resorted to more Reader data in a physical location, so the technical difficulty is the most difficult, and its harmfulness is also great. In addition, information privacy and location privacy reflect different aspects of privacy, and the two have differences and are related to each other. Information privacy It is static and is a description of a certain nature of the target; location privacy is a dynamic description of the privacy of the target, and the infringement of location privacy generally needs to be achieved with the help of information privacy.

4.4.2 Classification of RFID privacy protection methods

RFID privacy protection requires the security of RFID tags:Through the above analysis of RFID privacy classification and privacy attack methods, it can be seen that the root of RFID privacy problems is the uniqueness of RFID tags and the easy availability of tag data. Therefore, the security requirements of RFID tags have the following aspects

(1)RFID tag ID anonymity. Tag anonymity means that the message of the tag response does not reveal any available information of the tag identity. Encryption is one of the methods to protect the tag response. However, although the data of the tag is encrypted, if The encrypted data is fixed in each round of the protocol, and the attacker can still analyze the

identity of the label through the unique label identification. This is because the attacker can determine each label through the fixed encrypted data. Therefore, making the label information concealed is An important way to ensure the anonymity of the tag ID

(2)The randomness of the RFID tag ID. As in the previous analysis, even if the tag ID information is encrypted, because the tag ID is fixed, unauthorized scanning will also violate the location privacy of the tag holder. If the tag ID is a variable, the tag will be output every time Different, privacy invaders cannot obtain the same tag information through fixed output, so that the ID tracking problem and the privacy threat problem of information inference can be solved within a certain range.

(3)The forward security of RFID tags. The so-called forward security of RFID tags means that even if the privacy intruder obtains the encrypted information stored in the tag, he cannot go back to the current information and obtain the historical event data of the tag. In other words, the privacy intruder cannot pass Contact current data and historical data to analyze labels to obtain target consumer privacy information.

(4)RFID tag access control. RFID tag access control means that the tag can determine the authority to read the RFID tag data as needed. Through access control, it can avoid scanning by unauthorized RFID

readers and ensure that only authorized RFID reads Writers can obtain RFID tags and related privacy data. Access control plays an important role in realizing the privacy protection of RFID tags.

Classification of RFID privacy protection methods:

According to the analysis of RFID privacy, privacy attack methods and technical means, and privacy security requirements, the basic methods of RFID privacy protection include

(1)Change relevance: change the relevance of RFID tags to specific targets (such as people)

(2)Change uniqueness: change the uniqueness of RFID tag output information

(3)Hidden information: hide the RFID tag identifier and the data stored in the RFID tag

Change relevance:

The so-called changing the association between an RFID tag and a specific target is to cancel the connection between the RFID tag and its attached items. For example, after purchasing a wallet with an RFID tag attached, a certain connection is established between the RFID tag and the wallet. To change the relationship between them is to adopt technology and non-technical means, cancel the established association between them (such as discarding RFID tags).The basic methods to change the relevance of RFID tags to specific targets include discarding,

destroying and sleeping

(a)Discarding: Discarding refers to the removal of an RFID tag from an article and then abandoning it. For example, after purchasing an RFID tag-based attachment, discard the attached RFID tag. Discarding does not involve technical means, so it is simple and easy, but discarding There are many problems with the method: First of all, the purpose of using RFID technology is not only sales, it also includes after-sales, maintenance and other links. Therefore, if you simply discard the RFID tag, you will be able to return, exchange, repair, and after-sales service. There may be many problems; secondly, the discarded RFID tags will face the threat of garbage collection as described above, so they cannot solve the privacy problem; finally, if they are not handled properly, the discarding of RFID tags will also bring environmental protection and other issues.

(b) Destroying (killing): Destroying refers to making the RFID tag enter a permanent invalid state. Destroying can be to destroy the circuit of the RFID tag, or it can destroy the data of the RFID tag. For example, if the circuit of the RFID tag is destroyed, not only the tag cannot be sent to the The RFID reader returns data, and even if it is physically analyzed, the relevant data may not be obtained. Destruction requires technical means, which may be difficult for ordinary users, and generally requires the help of specific equipment to achieve, so it is difficult to achieve Larger.

Compared with discarding, because the label can no longer be used, there is no threat such as garbage collection. However, after the label is destroyed, it will also face problems such as after-sales service.

(c) Sleeping: Sleeping is to make the label enter a temporary invalid state through technical or non-technical means, and the label can be reactivated when needed. This method has significant advantages: because it can be reactivated, it avoids the need for after-sales service. Because of the problem of RFID tags, and there will be no garbage collection attacks and environmental protection issues. But like destruction, it requires the help of professionals to achieve tag sleep.

Change uniqueness:Changing the uniqueness of the output information of the RFID tag means that the RFID tag returns a different RFID serial number every time it responds to the request of the RFID reader. Whether it is a tracking attack or a listing attack, it is largely due to the return of the RFID tag each time The serial numbers are the same. Therefore, the solution another method of RFID privacy is to change the uniqueness of the serial number. Changing RFID tag data requires technical support. Depending on the technology used, the main methods include tag renaming-based methods and cryptographic-based methods.

Hide information:Hiding an RFID tag refers to preventing RFID tag data from being obtained by the reader or obstructing the reader from obtaining tag data. The basic methods of hiding RFID tags include

agent-based methods, distance measurement-based methods, and Methods of blocking, etc.

4.4.3Analysis of typical RFID privacy protection methods

Privacy protection technology based on changing the relevance of RFID tags to specific targets.

Removable label privacy protection method:In the removable tag privacy protection technology, the RFID tag used is a removable tag. When privacy protection is not required, the tag is removed from the product to achieve the purpose of protection. However, due to removal The label loses the advantages of RFID, such as product maintenance, etc., which will bring difficulties. In addition, how to store and dispose of the label after it is removed is also a difficult problem. If it is not handled properly, it may cause garbage collection threats and environmental protection issues. Therefore, Strictly speaking, removable labels are not a privacy protection method.

Modifiable label:Another way to modify the tag information is to physically provide the function of modifying the tag (clipped tag). By considering the design of tags from the perspective of physical characteristics such as packaging, users can physically modify the state of the tags to prevent information leakage. There are two design methods for tags that achieve this function.In Figure4-19, there is an isolation layer between the tag chip and the antenna. The isolation layer can be a

scrapable material (as shown in Figure4-19(a)) or a removable narrowband (as shown in Figure4-19(b)). Show), or a removable outer layer (as shown in Figure4-19(c)). When you need to prevent the label data from being illegally read to provide privacy protection, you only need to remove the scrapable material, narrow band or outer layer. The connection between the antenna and the chip can be cut off, thereby making the tag physically invalid. The advantage of this method is that the user operation is very simple and does not require additional tools or RFID readers. The disadvantage is that the design cost is high, and in general It is an irreversible damage to the RFID tag. Of course, with higher technical means, the attacker can restore the connection between the antenna and the chip by re-applying a layer of material, and regain the data on the tag.

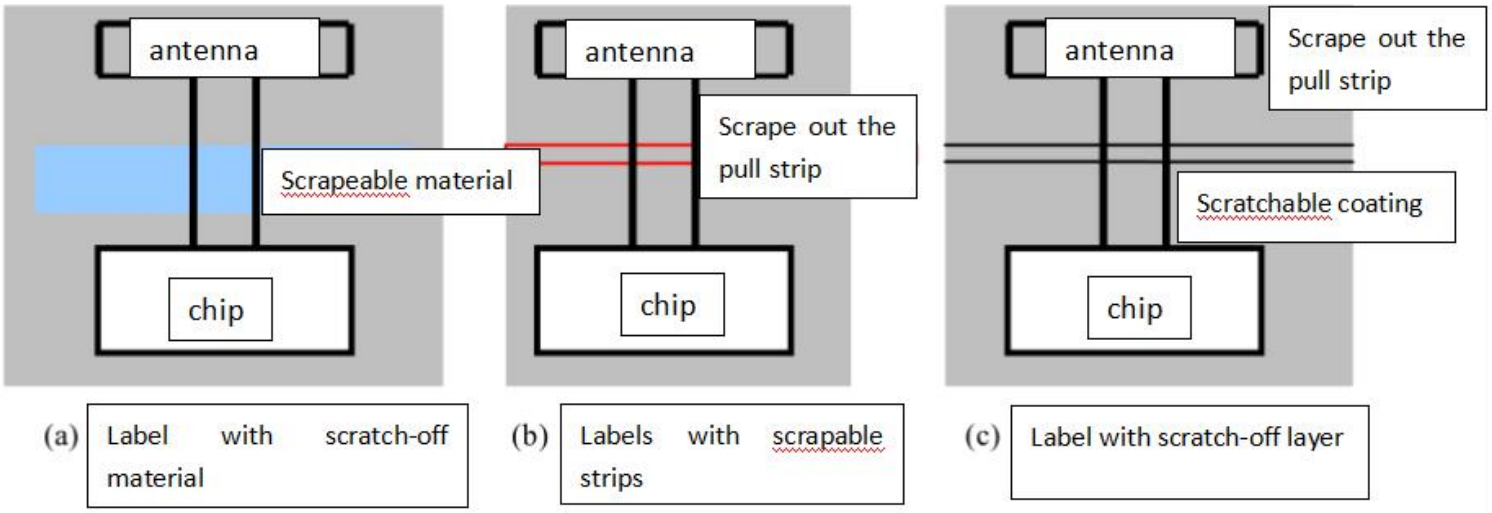

Figure 4-19 The RFID privacy protection scheme with physical feature

Labels support methods for terminating commands:The so-called method that the tag supports the termination command means that the Tag supports the kill command to make itself enter a permanent invalid state. The so-called permanent failure state (dead) refers to the physical method of destroying the internal structure of the tag so that it cannot respond to anything For the read and write request of the RFID reader, its internal data is also unable to recover. The way to implement the Kill command can be to destroy the power supply, or it can be a short circuit, etc. Many commercial RFID tags support the termination command. For tags that support the Kill command, the user only needs to use the Reader to send the Kill command to the Tag, the latter Can automatically enter the invalid state to ensure that private information will not be leaked.The advantages of this method are simplicity, low cost, and no special requirements for RFID tags. Its disadvantage is that there are hidden safety hazards. Because there is no safety guarantee mechanism, anyone can send a Kill command to the tag through the card reader, which can directly invalidate the tag. For example, a malicious attacker can launch an attack by sending a Kill command to make tags that shouldn't sleep enter the sleep state, thereby destroying the usability of the RFID system.

Label support password protection termination command method:The basic function of the termination command method that supports

password protection is the same as the Kill command method, but after the Tag receives the termination command, it must verify the legitimacy of the card reader that sent the Kill command. The verification process verifies a protected password (PIN) to achieve. For example, for EPC Class-1And Gen-2 type tag, it will store a 32-bit unique identifier (PIN) in the local storage area. When the reader sends a Kill command to the Tag, it must also send the PIN to the tag. The Tag receives the Kill command and After the corresponding PIN, it is compared with the locally stored PIN: if it is the same, the verification is passed and the Tag enters the invalid state; otherwise, the Kill command is ignored.Similar to the simple termination-sleep method, this method has the advantages of simplicity and low requirements for RFID tags, that is, RFID tags only need to have the ability to store PINs. The disadvantage is that there is a forward security risk. Due to the sent PIN It is transmitted in plain text, so it is easy for an attacker to intercept it. After obtaining the information of the PIN, the attacker can associate the PIN with the previous information, and then use the PIN to obtain the previous information of the Tag, destroying the forward confidentiality of the RFID. The need to store PINs increases the cost of RFID slightly. In addition, when there are a large number of RFID tags, the RFID reader needs to store the PINs of all tags. Therefore, storing and updating PINs is also a huge problem.How the tag supports the sleep command:The basic idea

of the tag supporting the sleep command method is the same as that of the tag that supports PIN protection, except that when the PIN is verified and passed, the tag enters the sleep state (sleeping) instead of entering the permanent invalid state. When you need to wake it up, you only need to send it to the tag The same PIN is sufficient. Like tags that support PIN protection, because the PIN sent before it enters the sleep state may be eavesdropped by attackers or malicious users, it is easy to be used to launch replay attacks to obtain the RFID tag data.

Physical trigger switch method:The physical trigger switch method refers to: By setting a physical trigger on the Tag, sleep and wake-up are realized by physical contact. When privacy is required, the physical switch can be triggered to enter the sleep state; and when the tag information is needed to perform During other operations (such as maintenance), the wake-up switch can be triggered to restore the tag to its normal state. Since PIN protection is not required, this solution is simple and easy to implement. However, if the attacker obtains the tag, the protection function is lost. In addition, physical switches will also increase the difficulty of label design and manufacturing costs.

Chapter 5 Conclusion

In the "Industry 3.0" manufacturing plant, the manufacturing and material management still remain in a self-operating information entity, but the materials depend on each link of the production process. People and materials, materials and machines are closely related to each other. It is not only important The core also plays a key role. Poor materials or material program errors will cause serious losses, especially the panel industry has more than a thousand kinds of process materials, spare parts, raw materials, etc., and the existing traditional material management operations Even if it has a well-established operating system, it will be difficult to optimize management efficiency. In the face of the intelligent trend of "Industry 4.0", without the introduction of automated management technology, the manufacturing industry will face realistic competitive pressures.

Under the development of "intelligence", many international manufacturing industries have also begun to use RFID technology to manage production lines, spare parts, raw materials, and personnel, and use the Internet of Things through RFID self-awareness and long-distance, fast, accurate, and automated Reading function and technology, collecting information and data in the operation link, and then using the back-end system connection, collecting and exploring the data, mining and analyzing valuable information from the data, and

providing decision-making information in production management and production The operation application in the process achieves the collaborative operation of man, machine and material.

Based on the background of manufacturing process materials and production management, this research explores intelligent solutions based on RFID radio frequency identification systems under the framework of "Industry 4.0". It can be seen from the comprehensive benefit analysis of the individual companies that the application of RFID technology to intelligent material management is of great help to the material management and production management of the manufacturing plant, whether it is obvious or hidden benefits, such as: reduction of operating time, Reducing human steps, reducing human judgment, simplifying production operations, improving inventory management, reducing replenishment time, improving inventory accuracy, reducing inventory labor, reducing manpower checking materials, preventing improper use of materials, preventing improper operations, etc. are all significant Effect, improve the production execution efficiency and management efficiency of manufacturing, and increase the number of personnel in the system.The confirmation time of the process flow, assists in turning the operator into the role of process supervisor, and achieves the goal of intelligence.

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