

# The Development of RFID based Production Management System

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## Abstract

We present a platform of Intelligent Integrated RFID (II-RFID) system, which integrate RFID data acquisition, enterprise applications and automated decision support. This paper focuses on the implementation of the II-RFID system in the field of production management. The experiment result shows that the combination of RFID and production management system will improve the productivity and traceability of manufacturing process.

**Keywords:** RFID, EPCIS, production management, system integration

## 1. Introduction

Many manufacturing companies deploy new information systems to trace and track production activities and physical objects, in order to make immediate decisions to handle any emergent events that could cause production disruption or customer dissatisfaction. Therefore employing mass customization, JIT (Just in Time), SFIS (Shop Floor Integrated System), lean production, together with real-time BI (Business Intelligent), DM (data mining) enables a company to achieve that aim and survive in today's high competition environment.

Radio Frequency Identification (RFID) is one of numerous technologies grouped

under the term of Automatic Identification (Auto ID). Auto ID technologies are a new way of controlling information and material flow, especially suitable for large production networks [1].

RFID is the use of a wireless non-contact radio system to transfer data from a tag attached to an object, for the purposes of identification and tracking. The technology can be used to identify, track, sort or detect a wide variety of objects [2, 3]. Recently, RFID becomes a more and more interesting technology in many fields such as agriculture [4], manufacturing [5] and supply chain management [6].

In this paper, the architecture and functions of the system of a RFID based production management system has been developed. Operators and managers are able to get more effective and correct production information within short time, make fast response and right decisions. Further research will be focused on the integration of the system with MES and ERP to reach Ubiquitous Manufacturing (UM) systems.

## 2. II-RFID System architecture

An II-RFID (Intelligent and Integrated RFID) system is generally set up to trace and track objects with RFID tags in a value chain of business shown in Fig. 1. The II-RFID system comprises six levels:

1. Assets level, which contains raw materials, equipment and finished goods
2. Data acquisition level, which consists of RFID tags, antennas and readers
3. Control level, which consists of PCs and middleware
4. Database level, which combines RFID database and other high level databases
5. Decision support level, which involves in data mining or computational intelligence approaches, and
6. Management Level, which provides management knowledge to managers.

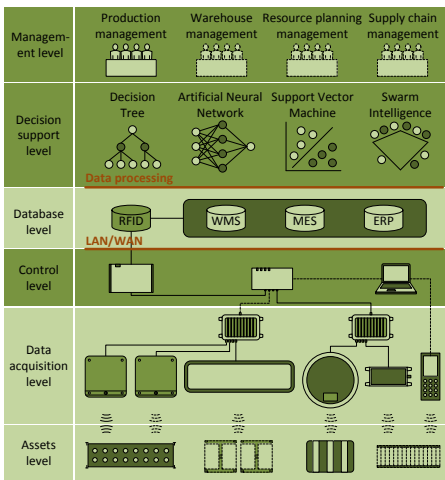


Fig. 1: System architecture of II-RFID system.

Any step in a value chain of business can benefit from the II-RFID system. However in this paper we will only focus on the development of RFID based manufacturing production system.

### 3. Functions of the production management system

The proposed production management system works according to the real-time collected RFID tag information. The following tasks based on RFID data acquisition can be reached:

1. Online part information collection
2. Online processing progress statistic

3. Daily processing capacity statistic per station
4. Total processing time for a batch of product and processing time of each working process
5. Production progress display and remaining processing time prediction
6. Quality statistic (including scrap and recall)

The main functions of the RFID production management system includes Working in Process (WIP) management, processing station management, manufacturing process management, production task management, personnel management and tool/fixture management.

1. WIP management: WIP registration; quality query; Product positioning and tracking, prediction of the remaining processing time.
2. Processing station management: Processing station registration and query, processing station output query, process information query.
3. Manufacturing process management: manufacturing process registration and query; manufacturing process management is the basis of production task schedule query.
4. Production task management: production task registration and query; production task schedule query.
5. Personnel management: personnel registration; personnel productivity and production query.
6. Tool and fixture management: tools/fixtures registration; tool position allocation.

### 4. Software and hardware

The hardware consists of the RFID printer, fixed readers, reader antennas, handheld readers, middleware and other IT equipment. (in Fig. 2)

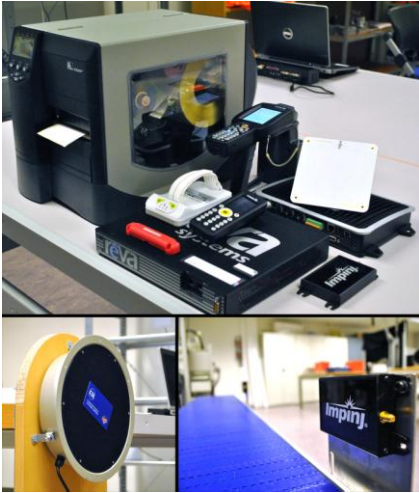


Fig. 2: Hardware of the II-RFID system.

The readers and antennas are configured with Reader Startup Tool. Meanwhile, the ODIN EasyTAP is used as the middleware which combines real-time adaptive control of RFID readers, device and sensor management and RFID tag data processing, which is controlled by the Middleware Management Console.

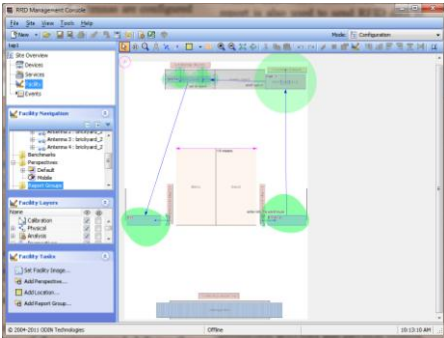


Fig. 3: Facility layout configuration in the middleware management console.

In the middleware management console, the working space is calibrated according to the layout reference image. Thus, the position of the antennas can be defined with respect to the actual shop floor layout is shown in Fig. 3.

The read points are set as locations on the basis of the antennas and used for generating event reports following respective standards e.g. ALE report and EPCIS report. The RFID information collected by readers is processed by the middleware according to the EPCIS standard, which carries the logistic information of the products. Then it is forwarded in the form of ALE report to a predefined IP address representing the RFID database or the interface of other high level databases.

## 5. Implementation

In our lab, six read points have been defined, including two working stations, two portals and two smart shelves. The configuration simulates both of the production line and warehouse of a plant.

The RFID database is set up in the local PC and receives RFID event data in the form of EPCIS report from the middleware. PROdog is used to call RFID database and perform the production management task which are shown in section 3. By inputting the correct IP address in the internet browser, PROdog can be run on the basis of the cloud database and achieve the remote configuration and monitoring.

Fig. 4 shows integrated function menu of the system. All the software functions such as material management and manufacturing management are included in the drop-down menu.

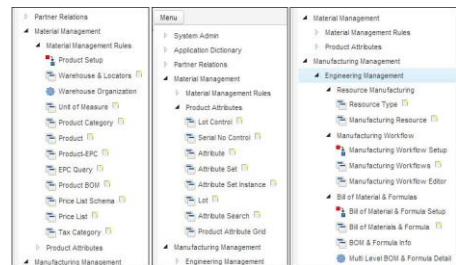


Fig. 4: Functions included in PROdog

The RFID database is built up on a PC within the same network. RFID data is reported by the middleware and stored in the database. The production information is real-time available by using PROdog, e.g. the product can be tracked according to history data in the form of report as shown in Fig 5:



Fig. 5: Product track report generated in PROdog.

Thus, the tagged products will be automatically registered when entering or leaving a special working station. Products can be track and trace within a short time which improves information flow and production efficiency.

## 6. Conclusion

The RFID based production management system is a sub-system of II\_RFID system and it is constructed with the software PROdog and based on the RFID data collected by the hardware system following the EPCIS standards. The middleware bridges the gap between the hardware system and software by generating ALE/EPCIS reports. The proposed production management system provides a feasible solution for monitoring real-time manufacturing information to companies. The results of experiment show that traceability of manufacturing process by the use of RFID is an enabling technology which allows the operators and managers to see and understand a given

process. It make doing business easier and effective at any level of factories.

Future works will extend the RFID based production management system to RFID based warehouse, logistics and supply chain management.

## 7. References

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