Chapter 1
Heavy Assembly Line Logistics System Based on RFID Applications

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Abstract Based on the production logistics in one heavy industry enterprise, this paper describes the logistics operation mode of the assembly process, analyses and designs the operation mode. By taking the advantage of RFID technology in the secondary sorting process of materials, the automatic sorting method is proposed, which improves the sorting speed and accuracy.

Keywords Assembly line • Heavy industry • Intra logistics • Mode of operation • RFID

Introduction

Heavy manufacturing industry is a complex manufacturing industry which has its own characteristics as follows: discrete manufacturing; Multi-species and small quantities production; numerous material suppliers; frequent production change; lots of uncertainties affecting the production; high quality requirements and so on (Liling Jiang 2008). These characteristics of heavy industry make the intra logistics

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quite complicate. With the advancement of technology and development of economic, the completion between different industries becomes more and more fierce. In order to improve the competitiveness of enterprises, the intra logistics becomes a problem that can't be ignored (Chen Chenghe 2007).

This paper describes the logistics of a company truck production line. In order to meet the rapid growth of market demand, the heavy enterprise expands its production capacity, builds new logistics system in the production factory, and introduces automatic logistics equipment (Cochran and Kaylani 2008; Cochran and Kim 1998a, b). Combining with the advancing management method, the logistics efficiency and accuracy are greatly improved. By using proper logistics operation mode, the objectives of waving off the shelf, online sorting, single-station distribution and real time sending are achieved.

Intra Logistics Mode of Operation

There are two main mode of intra logistics operation, which are Push-type system and Pull-type system.

The push-type system can be described as a top-down planning system because all production quantity decisions are derived from forecasted demand in the master production schedule. The system produces as many parts as previously forecasted. The parts are released to the next station as quickly as possible to avoid starvation at the downstream stations (Cochran and Kim 1998b; Flapper et al. 1991). This characteristic enables the system to reduce delivery leadtime since many semi-finished or finished products are available. Medium to large variation of demand may not cause any chaos because semi-finished products are kept at each station. The push-type system is better for planning and controlling production activities. However, it causes high volume of work-in-process(WIP), both in the form of semi-finished and finished products (Beamon and Bermudo 2000). As a result, the system suffers from high inventory holding cost.

The pull-type system drives productions based upon customer demand (as opposed to forecasted demand). Each station can be viewed as an isolated station with its own supplier (the upstream station) and its own customer (the downstream station). When a customer order is placed, it will be fulfilled from the finished product inventory (Bushée and Svestka 1999). As soon as the finished product is pulled from this inventory, a signal (or kanban) is generated to trigger production of the upstream station in order to replenish the finished product inventory (Rafaelpast 2000; Lee 1993). Similar procedures take place until the first station, where it pulls raw material from the raw material storage. The pull-type system can reduce WIP significantly. However, the system may not work well in an environment with medium to large demand variation because there is not enough semi-finished inventory kept. This in turn may result in a significant backorder. In addition, the pull-type system often has longer delivery leadtime than that of the push-type system, thus higher delivery late penalty costs.

Introduction of Intra Logistics in a Corporate

Lean Logistics Strategy

The logistics department of an enterprise uses the MM(Material Management) module in the SAP system to achieve material management currently. It's prepared to re-development the materials management module to realize the standardization and accuracy of logistics.

The new factory plans to enhance the management of the logistics process on the basis of existing materials management, including logistics scheduling and vehicle scheduling. In order to enhance the timeliness and transparency of the material delivery process, the new factory will carry out sophisticated management. Currently, the logistics model which the department of enterprise is applying is procuring, stocking and distribution according to plan order, which almost utilize push mode.

In order to let the production logistics be leaner, in-time and more transparent, we proposed the following push-pull distribution mode (Fig. 1.1)

As shown above, materials that require sending to the line we can sample divide into three categories. The first one: according to the division's master production schedule, the suppliers distribute the materials to the space of secondary sorting, and then sent to the side of production line after sorted. The second one: according to the division's master production schedule, the suppliers distribute the materials to warehouse, and on the basis of planning to put the materials off from the shelf, and then sent to the side of production line when the materials are needed. The third one: the suppliers send the materials to the side of production line directly when the materials is needed.

In order to be a good combination, Push distribution and pull distribution is also need a system to support. The figure below shows how to allocate push and pull distribution task (Fig. 1.2).

Push logistics:

MRP logic. Accordance with the ERP of the next day plan, starting with BOM, dispatchers pick materials to the production line or sorting area In advance (Olhager and Ostlund 1990).

The above is generally used for: (1) Materials supply and consumption are relatively stable situation. (2) The situation of less dosage or special order.

With the standardization of production logistics, the first case can be gradually replaced by the JIT.

Pull logistics:

JIT logic. According to the actually order of sending materials to the production line in the MES, dispatchers can real-time ration materials to the side of the production line or sorting area (Spearman and Zazamis 1992; Takahashi and Nakamura 2004).

It is generally used for the materials of configuration differences and frequently used.

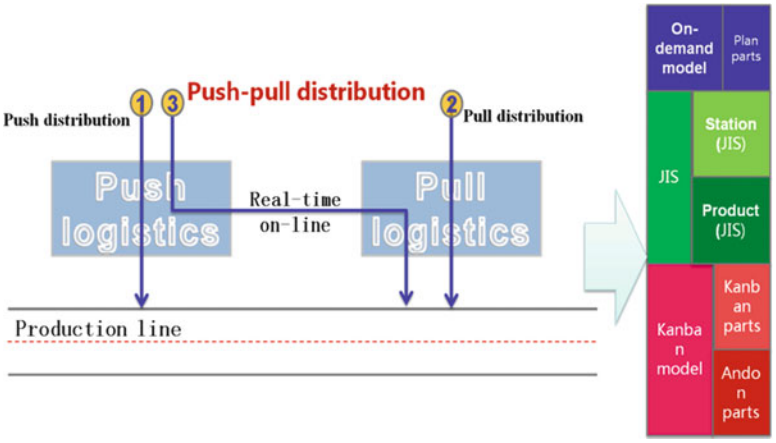

Fig. 1.1 Push-pull distribution

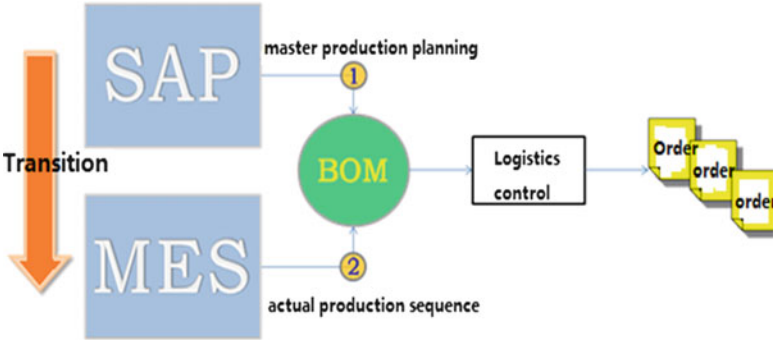

Fig. 1.2 Allocate push and pull distribution task

Intra Logistics Distribution Model

All logistics way in the 18th plant of the division are as shown below (Fig. 1.3):

1. According to production plan generated by the APS , LES will automatically generate the picking list, and then deliver to the various storages.
2. According to the picking list, the pickers start to picking.
3. The materials which need not secondary sorting from the stereoscopic warehouse is sent to conveyor by forklift truck, and then to production line by AGV.
4. The materials which need secondary sorting from the stereoscopic warehouse is sent to secondary sorting area by forklift truck, and then grouped with the other materials from other storage. After grouping, sent to conveyor by forklift truck, then sent to production line by AGV.

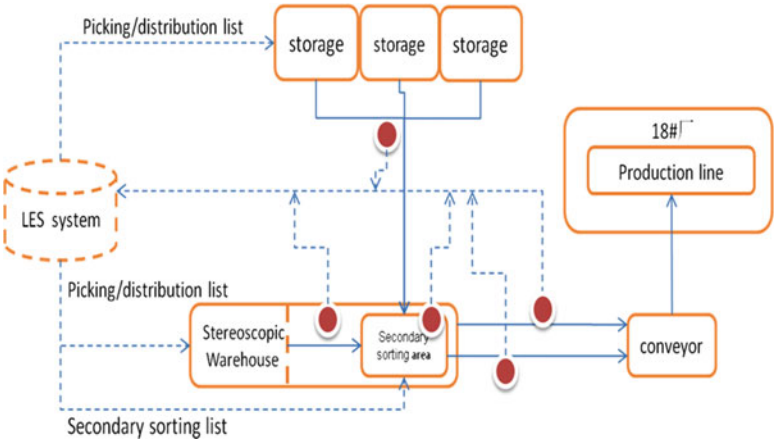

Fig. 1.3 Logistics way in the 18th plant of the division

5. The forklift smart distribution module of LES and the AGV system achieve the automated collaborative distribution throughout the whole distribution process.

The Difficulty of the Logistics Process

The most difficult in the whole logistics process is the material of the secondary sorting. The secondary sorting area is mainly used to group materials from the stereoscopic warehouse, other warehouses and suppliers direct supply materials.

However, secondary sorting area space is limited. There is no place to store the materials from the stereoscopic warehouse, which need group with the materials from other storage. The regional distribution of the secondary sorting area is as shown below (Fig. 1.4).

Materials of Group Based on RFID Applications

Introduction of RFID System

The Fig. 1.5 shows the process that RFID readers to write material information to the RFID tag.

1. The system will send the information of materials which is prepared to sort to the RFID reader.
2. RFID reader send the information to the RFID tags on the sorting small cart, through the wireless.

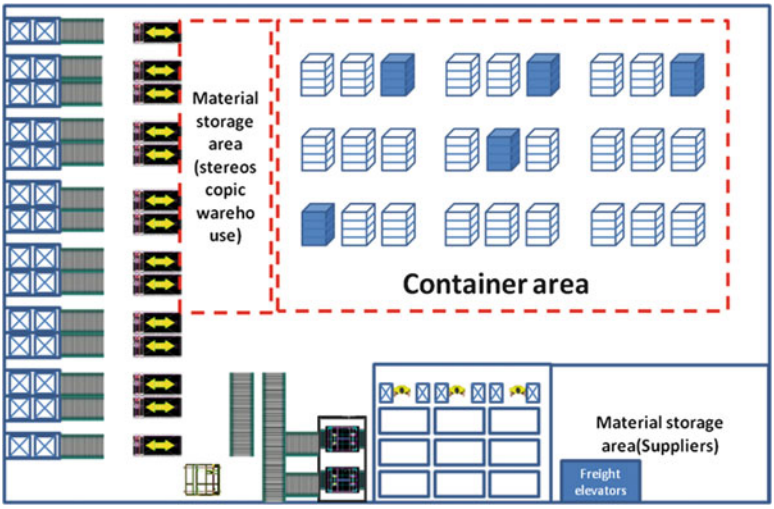

Fig. 1.4 The regional distribution of the secondary sorting area

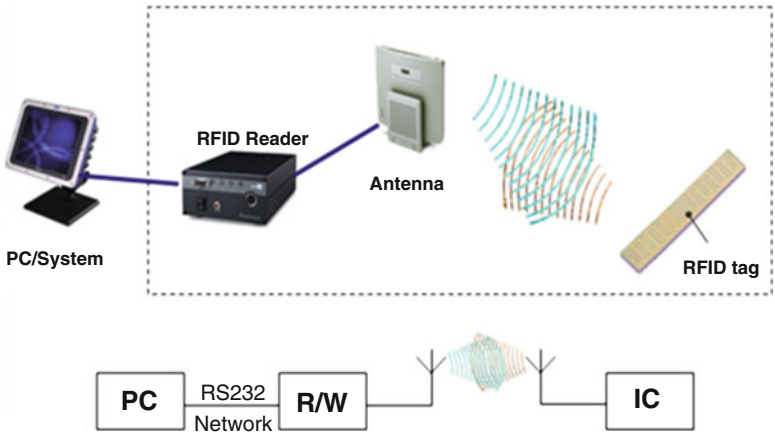

Fig. 1.5 The structure of RFID system

Group Process Based on the RFID Application

There is only one tray on a shelf in stereoscopic warehouse, materials place on the tray. One tray could be put one or more kinds of material, and each type of material does not have mark. The material from the stereoscopic warehouse need carry out a sorting, which let the material into the sorting cart and write material information into the RFID tags on the sorting cart (Fig. 1.6).

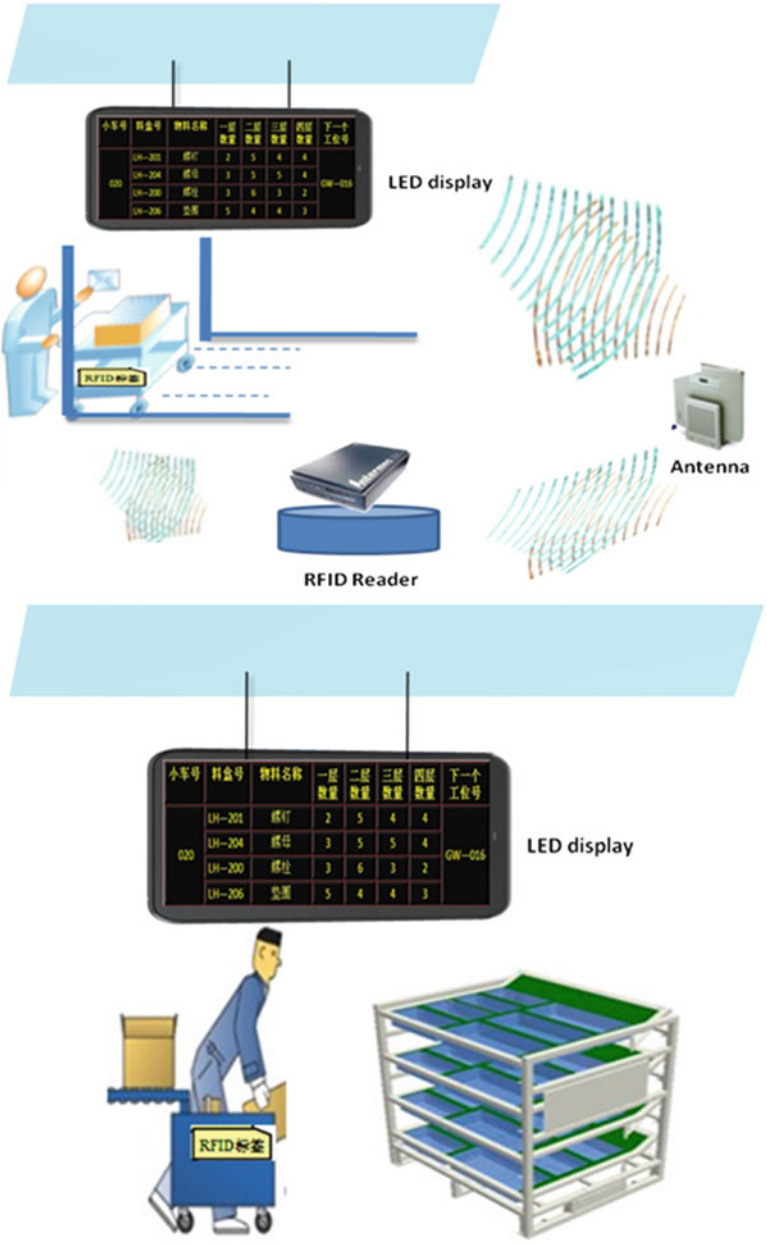

Fig. 1.6 The group process

The group process:

1. Sorting workers push the transport cart which carried full of materials to the entrance of group area.
2. When the sorting workers passed the entrance, the RFID reader at the entrance would read the information from the RFID tags on the cart.
3. After disposing by the background, the LED display at the entrance would show the group location where the sorting workers should to go. Then the works will go where the LED wanting him to go.
4. When the worker arrived the designated locations, the LED display at the designated location would show the sorting information.
5. After complete the sorting, the worker would press the LED control terminal to tell the system you have done.
6. The information showed by the LED display would be changed to next place the work should to go.
7. When the materials on the cart were all throw in the container, the LED display would show nothing.

Conclusion

The 18th plant of the division take the full use of push-pull distribution logistics, stereoscopic warehouse, AGV, RFID and so on, which greatly improve the logistics efficiency and make the materials stacked better beside the line.

In the material sorting process, the use of RFID technology make the material identification become more accuracy, and the identification distance become more flexible since its advantage of reading information without barrier. Combining the LED display, the secondary sorting speed is improved and the problem of insufficient sorting space is also solved.

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