

RFID at the Raytheon Integrated Air Defense Center

Introduction

Raytheon Company was founded in Cambridge, Massachusetts in 1922¹. Its core competencies have evolved in the past 80 years, but the company has been the leader in innovating technologies based on radio frequency and radar. The Integrated Air Defense Center (IADC) was initially constructed in the 1970s², and has since grown into a 1 million square foot manufacturing facility with over 3000 employees. The facility is organized around product lines. Dozens of different products are manufactured and supported by the IADC.

In 2004, the Department of Defense (DoD) finalized its Radio Frequency Identification (RFID) policy, which requires suppliers to put RFID tags on their shipments. The supply chain team at Raytheon's Integrated Air Defense Center had just completed a project to achieve compliance to this policy. The final solution was quite simple: an RFID Label Printer was programmed to print barcode labels with a tag inlay. Shipping personnel use this printer to create labels as they prepare crates for outbound pickup. While there had been some challenges, the process had not changed very much from the operator's point of view.

The compliance project was highly visible, and its success had upper management wondering what the possibilities were for using RFID for efficiency improvements within the facility. The last few years had uncovered deficiencies in inventory visibility and cycle time through the shipment receipt process. A number of articles had been published in industry magazines touting the ability of RFID to help solve this problem. A number of possible usage scenarios - discrete uses of RFID - were cited in these articles, and some might have been applicable to the IADC.

Based on their success with the compliance project, the team was now tasked with identifying possible improvements, developing a recommendation on what to do, and agreeing to an implementation plan if applicable.

Incoming material distribution process

Materials arrive into the IADC facility through one of four standard-sized dock doors. On average, 250 shipping lots arrive each day. The majority of these arrive through global parcel services like UPS® or Federal Express®, with larger items will arriving in trailers or on delivery runs from other Raytheon facilities. Most deliveries occur in the morning, resulting in a backlog which is processed throughout the rest of the day.

¹ www.raytheon.com

² Balazs, Brett, "Transforming data into information to control and improve a ribbon bonding process" (S.M. thesis, Massachusetts Institute of Technology, 2004), p. 15.

When they arrive, the incoming shipments are looked up in the receiving IT system, where they may be associated with a specific purchase order. Approximately 40% of the packages have a Raytheon-specific barcode attached which facilitates this lookup process. Operators will look at the packing slips of the other packages. The IT system then prints a label which is applied to all the incoming shipments. This label becomes the identifier for this shipment container throughout the rest of the warehouse receiving process. All packages go through this step.

After affixing the label, the operator places the product in one of 60 temporary storage racks depending upon the next step in the process flow. The operator currently uses a handheld barcode scanner scan both the box and rack in order to update the system with location information. Material will often move from rack to rack as it undergoes processing in the warehouse. RFID readers installed on the rack could make this scan unnecessary and perhaps reduce the number of items misplaced during this step in the process. These racks are currently made of metal, however, which would negatively impact RFID performance.

The next steps in the process depend upon the characteristics of the package and material inside. One of the first decisions is whether the package contains material which will be going into an assembled product. "Product" encompasses all parts which will be integrated into a subassembly or final product. "Non-product" encompasses all the items which will not. Non-product can include letters, desktop computers, MRO items, urgent deliveries and tools.

Unlike many commercial facilities, at the IADC non-product deliveries come through the loading dock instead of through a separate mailroom. Facility security is one of the drivers behind this decision, as monitoring is easier with a single point of entry. Approximately 90 packages a day are non-product and will be placed in a rack depending upon its final destination. Five operators deliver these packages to the manufacturing floor or point-of-use destinations like offices and cubicles. Delivery is confirmed with a final scan at the destination location. The shipping box is "detrashed" (opened and thrown away) at the final destination only by the recipient, and the flow of this material effectively ends here.

The remaining "Product" falls into one of two main categories. Some of the material will come from Raytheon's strategic partners. These have been able to meet quality guidelines to the extent that their shipments do not require inspection before proceeding to the manufacturing floor. This Vendor Qualified Product (VQP) accounts for 40-45 shipments per day.

The majority of "Product" will require some inspection before going to the floor. On average 120 packages per day are placed on one of the inspection racks. Using a priority system, operators take packages from the inspection racks into the inspection area in a room next to the warehouse. There the container is scanned, opened and the product inspected as per the defined protocol. The inspection process can be very in-depth, depending upon the type of material involved. After inspection, the product is returned to the box and resealed before being returned to one of the storage racks.

Some of the inspected product, however, will not immediately pass inspection and will need to be escalated to the engineering group. Inbound Engineering Services

(IES) is responsible for troubleshooting first-round failures and receives approximately 40 shipments per week. IES is located down the hall from the warehouse, and receive deliveries a few times a day. The material label is scanned when it arrives and leaves the IES area. Some material will fail this inspection step, resulting in a return to the vendor, while other material will be deemed acceptable for manufacturing use.

Once all the material has passed or circumvented inspection (by virtue of being vendor-qualified), a decision is made on where it will be stored until needed by the manufacturing floor. Large items are considered “Bulk” and will be stored in 50 foot tall warehouse shelving racks. These include system controllers and structural components³. These will ultimately be delivered directly to the floor and bypass the main stores carousels described later in this section.

Smaller parts reach the manufacturing floor through a different process. Before the material is put into storage, it must be inducted into the Andover Warehouse Control System (AWCS). The shipping container is scanned for a final time as it enters the AWCS induction area and the material is removed from its shipping container. The container is detashed at this time.

Generally the containers’ contents are separated into individual items. For high quantities of very small items, however, the parts are grouped into quantities of 10, 20 or 50. Examples of these types of items are diodes, resistors and some connectors. The individual parts or groups are repackaged into small storage containers. These are usually electrostatic discharge (ESD) bags. These act as a Faraday shield protecting the components from electrical shock. These bags also shunt the antennas of any RFID tags applied directly to them, rendering them inoperable.

Each of these small containers is bound for the main stores carousels, and for this reason we will refer to them as “carousel stock”. The operator prints labels for each of carousel stock containers, which creates an entry for them in AWCS. The label is called a Product ID (PID) and has barcodes & human readable components which specify the part number and random carousel storage location it will reside in. The containers are then placed on a “To Stores” rack. Approximately 44,000 PIDs are created each year. The full flow of the warehouse receiving process is shown in Figure 1.

After the material is placed on the “To Stores” rack, control of the process and responsibility for the material is transitioned to the Main Stores department. The role of the receiving department is to sort, qualify and distribute material. Main Stores, on the other hand, is tasked with storing this material until needed by the manufacturing floor. It then delivers a consolidated set of several different parts in a kit to support manufacturing. The process flow through Main Stores is essentially linear, but dwell time for any specific item can vary considerably. This flow is shown in Figure 2.

³ In practice, “larger” items are those that don’t fit into the 24” x 6” x 18” carousel containers.

The most obvious aspect of the Main Stores area is the 27 carousels which take up most of the available floor space. Each is nearly 12 feet high, 6 feet wide and over 40 feet deep and contains thousands of wood or cardboard storage location bins. 17 Lifts stations service the carousels, with some placed so that the operator can run two carousels. The carousels are computer controlled, and entering a storage location number will rotate the carousel until that storage location is presented to the operator. A carousel and lift station is shown in Error! Reference source not found..

The first step of the Main Stores process is to put the PID-labeled carousel stock into the carousels. An operator picks up recently inducted stock from the “To Stores” racks in the warehouse. As over 180 PIDs are created daily, this pickup happens several times a day. Once the operator arrives in Main Stores, he or she places the material into the receipt racks on the correct lift station. The receipt racks are the light blue bins shown in Error! Reference source not found..

The operator assigned to that carousel will scan barcodes on the package and place the material into the storage location. Note that the PID label is not scanned between AWCS induction and the actual “put away” action. Also note that there is no consolidation occurring: if the part number is already stored somewhere within the carousel, the two carousel stock containers are not combined.

The material now waits for customer need to trigger a “pick” of the part. This need is transmitted through several MRP systems, but the information ultimately enters AWCS and is prioritized. The customer usually requests a kit of parts, sufficient to support the manufacture of one or more end items or subassemblies. Depending upon the part number and customer need, the carousel stock may be resident in the carousel for anywhere from a few days to years.

Remember that the PID label may be affixed to a carousel stock container with one or more items inside. The kit may not require all the pieces within the carousel stock container, and so the remaining carousel stock is returned to storage location (the quantity remaining is updated in AWCS). Another possibility is that the kit requires more than the quantity of a part stored in any one carousel stock container. In this case, more than one carousel stock container will be opened and emptied.

When a part is requested, an operator pulls the correct quantity from the carousel stock and applies a new identifying label, the “pick label” to a new ESD bag container. In addition, more than one pick label might be printed since the carousel stock containers might be at different lift stations and therefore not easily put into the same pick label bag. In any case, emptied carousel stock containers are detashed, and we will call the new container the picked parts. Approximately 1700 Pick Labels are printed each day, implying that an even greater number of individual pieces are requested.

The picked parts are carried to the consolidation area, which is past the end of a long aisle of carousel lift stations. The pick label is scanned here, and once all the components of the kit arrive into the consolidation area, the kit is sent to the manufacturing floor. This effectively ends the incoming material process flow.

There are dozens of internal customers for the materials distribution process. Defense companies are characterized by a large number of long-term programs, and the IADC is no exception. There are a few key manufacturing lines within the plant, and these comprise the bulk of incoming packages and request the majority of kits from main stores. It's possible that a complete analysis of material flow through the IADC (inbound, manufacturing and outbound delivery) might be worthwhile. Evaluating the inbound flow, however, became the focus of initial analysis.

The kickoff meeting

Each of the team members had participated in the DoD compliance project and now commanded a good understanding of RFID technology. They had attended an RFID training course, and had even used Six Sigma techniques to improve the read reliability of tags placed on shipping containers. The team scheduled a 90 minute meeting to kickoff the evaluation project, with the hopes of agreeing to a process for developing a business case.

In the project kickoff meeting, the team debated several aspects of the incoming materials process and how RFID might solve some of the problems. It quickly became apparent that identifying process improvements was completely different from complying with a mandated requirement. Several questions were raised in the meeting:

- Who should be on the evaluation team?
- What support would they need from upper management? Should the proposed deliverables be modified?
- Should they suggest expanding the project scope beyond inbound materials, just focus on either the warehouse or main stores, or leave the scope as is?
- How would they identify possible RFID usage scenarios? Once identified, how would they calculate the costs and benefits?
- How much non-RFID improvement should be lumped into this project? Should they consider totally re-engineering processes or overlay existing processes with an RFID system?
- How could they share the knowledge gained during this evaluation with other Raytheon teams in other facilities?

By the end of the meeting, nothing had been decided and the initial optimism supporting the project had faded. As each member walked back to their desk, they wondered how to proceed.

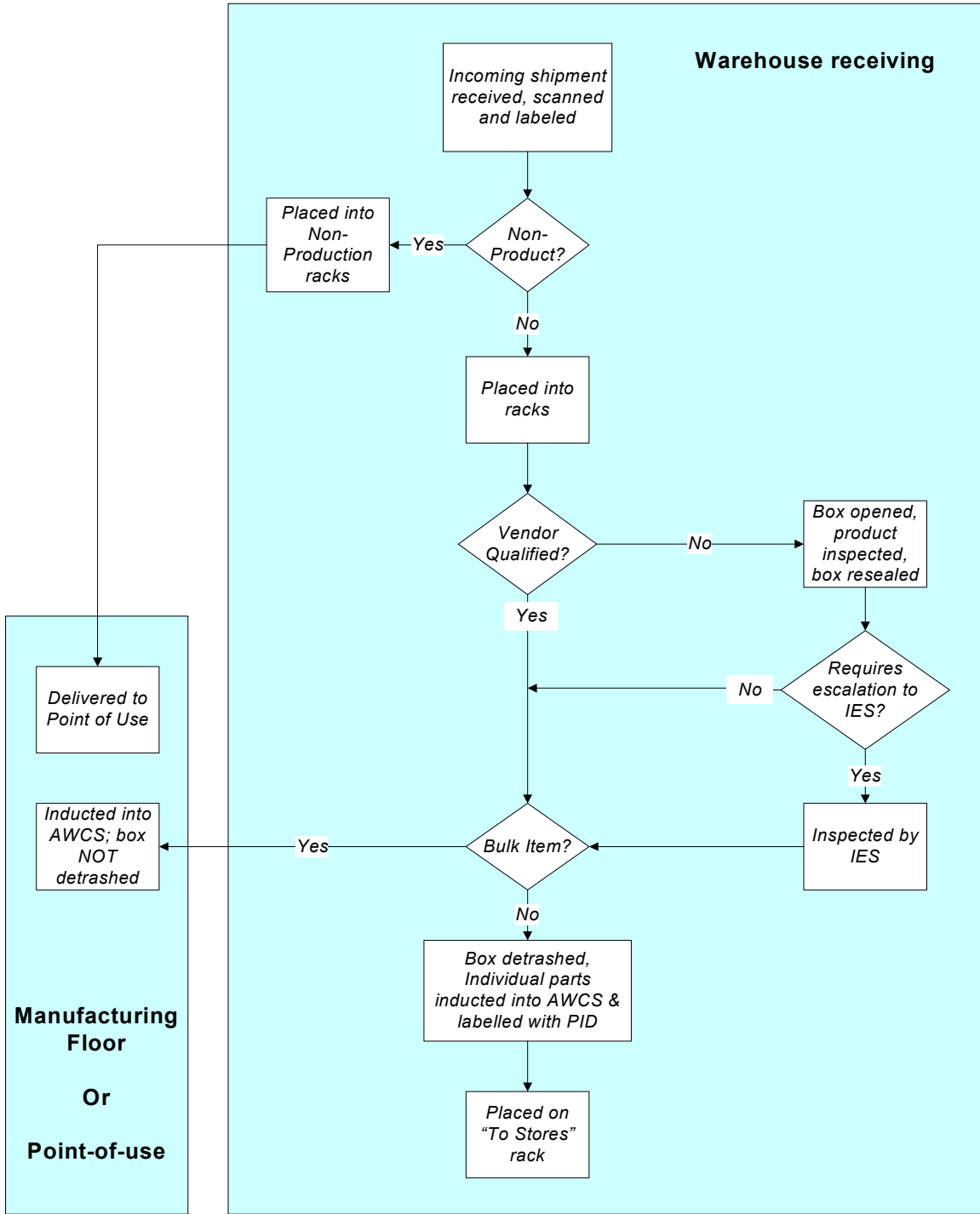


Figure 1: Warehouse receiving material flow

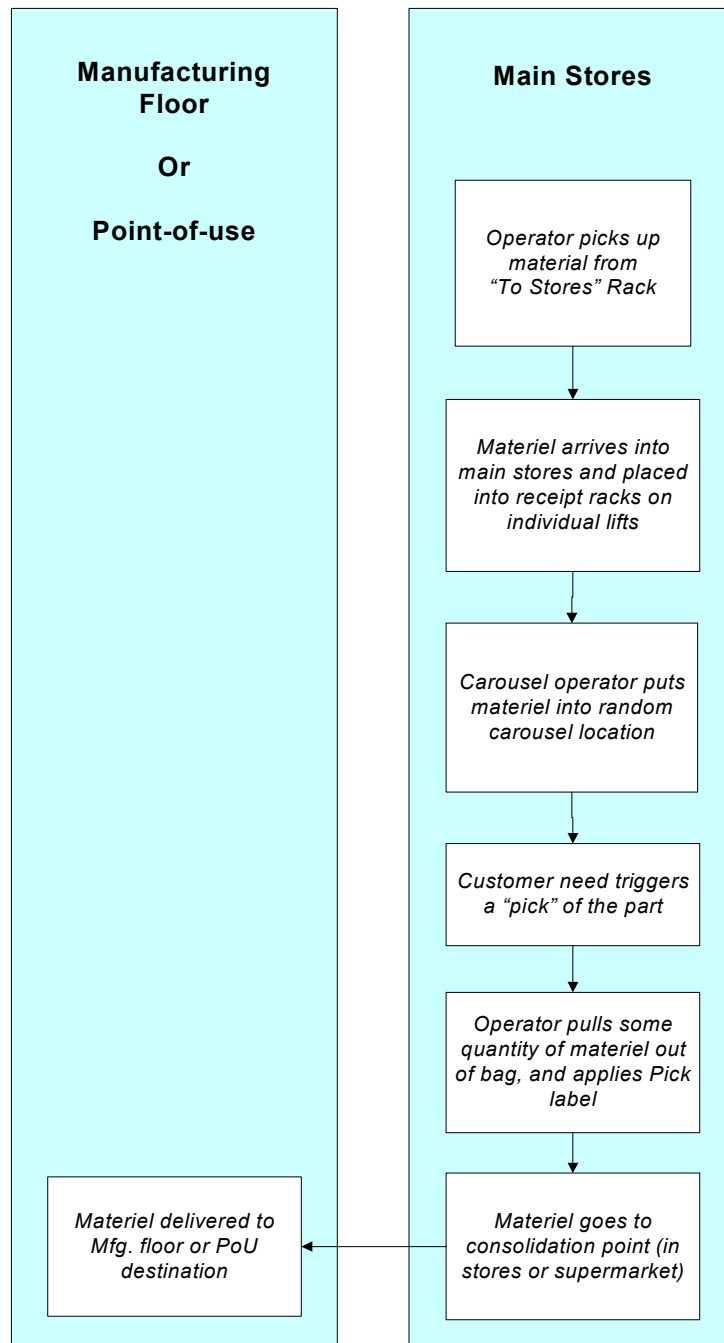


Figure 2: Main Stores material flow