Automatic Identification – When to Use RFID

A Case Study on Selecting AIDC Technologies by the U.S. Postal Service

Introduction to AIDC, Barcode, and RFID

Radio Frequency Identification (RFID) and barcodes are two dominant technologies in Automatic Identification and Data Capture (AIDC). Other AIDC technologies include smart card, magnetic strips, and touch memory. The core functions of an AIDC technology are to apply an identification code to an object or store other information, and read the code or information at a later date for identification or tracking purposes with minimal human intervention.

Barcode technology is based on spatially modulated patterns printed on suitable substrate (such as paper) to encode static information. Barcode readers with line-of-sight with respect to the barcode can automatically locate and decode the barcode at high speed with very high reliability. With the adoption of Universal Product Code (UPC) for retail product labeling in 1974, barcode has become the ubiquitous AIDC technology in material distribution and retail operations.

RFID is based on a tag consisting of an electronic chip and antenna that responds to a reader using radio frequency signals to decode the information encoded in the chip. RFID offers several advantages over barcode identification, including a higher information carrying capacity, the ability to change the information encoded, and a longer read range without the direct line-of-sight requirements. While RFID has become a hot topic over the past several years, its applications started several decades ago. Retail stores began to use RFID as electronic article surveillance for antitheft purposes in the 1970's. Wild life management and the cattle industry also began to use RFID to tag and track animals. Electronic toll collection and security access using RFID became widespread in the 1980's. Applying RFID to supply chain management and material distribution began to gain popularity in the 1990's.

Facing the RFID Challenge

With the U.S. Department of Defense and large retailers like Wal-Mart mandating the use of RFID in their supply chain, RFID has been looked upon by various industries as an emerging technology that will some day replace barcodes. Many organizations are facing, or will soon face, an important task of having a technology strategy to adopt RFID when and where it is appropriate or mandatory. ICF

Consulting provides technology management consulting services to various clients to help them understand how their organizations should be positioned to respond to this seemingly unstoppable wave of change. This white paper provides an overview of our approach and experience with one of our clients, the U.S. Postal Service.*

Helping the U.S. Postal Service Determine the Appropriate AIDC Technology

Technology is not an end by itself; rather, it is a means to enhance business processes to support business objectives. Therefore, a thorough understanding of the client's business environment is an essential prerequisite for successful technology management consulting. For the U.S. Postal Service, 20 years of partnership helps ICF Consulting develop an in-depth understanding of the Postal Service business objectives, operations, current technology base, and long- and short-term technology strategies. For example, we are intimately familiar with the widespread use of barcodes to tag individual mail pieces and handling units. (Handling units are the aggregations of individual mail pieces. They include trays of letters and sacks of parcels.) Substantial investments have already been made over the past decades in mail processing and material handling equipment to apply barcodes to individual mail pieces and handling units, and scan them in subsequent sorting and distributing processes. We also have insights into how this infrastructure will evolve over the next 5-10 years to improve operational efficiency.

In 2000, ICF Consulting performed an in-depth analysis for the Postal Service to determine the appropriate AIDC technology to tag handling units and containers. (Containers are aggregation of handling units. They include a wide variety of rolling containers as well as palletized loads.) The analysis showed that the use of RFID technology to tag handling units is problematic for several reasons. First, the cost for both the tags and read-write infrastructure for RFID will be higher than barcode. Keep in mind that there are 60 million trays in circulation throughout the postal network! Second, in the intra-facility, operation-to-operation environment, the tag life will generally be very short, (only a few hours before the next operation,) and the cost per use will be high. Third, as more material handling becomes mechanized via programs like the Robotic Containerization System, the environment becomes ideally suited for barcode applications on handling units. In fact, systems, such as the Robotic Containerization System, are specifically designed to use barcode on

* Since the early 1980's, ICF Consulting's postal practice has been instrumental in assisting the US Postal Service in the development of its first Corporate Automation Plan, its first environmental management plan; the Interoperability (mail processing equipment messaging) specifications; advanced mail processing technologies, equipment, and operations; the Long Life Vehicle; the first National Change of Address System; the first National Compressed Address Directory; an electronic Delivery Confirmation system; the USPS Operations and Learning Centers, and automated vending equipment and electronic kiosks.

handling units. Therefore, for the short and medium-term, ICF Consulting recommended the continuing use of barcode to tag handing units. When RFID technology matures and its implementation cost is significantly reduced, it may become a more attractive technology in the future.

The situation is quite different when it comes to tagging containers. At the time the analysis was done, there was no AIDC infrastructure in place to tag and track containers.[†] Our analysis of the technologies and operations during the dock dispatch and receipt process led us to believe that the container loading and unloading (into and from transportation units) processes are not amendable to using barcode technology because it would significantly reduce the speed of operation and incur substantial labor and overhead costs. RFID, which allows passive data collection technology, would have minimal impact on operations. While the cost for RFID tags and infrastructure are higher than barcode, its impact is less severe since only nine million containers and pallets are in circulation, and tags will be reused many times before replacement. Moreover, the number of locations needed to be equipped to program and read the RF tags on containers will also be substantially fewer than in the case of handling units. The analysis also took into account the likely Universal Postal Union mandate to tag containers carrying international mail with RFID tags. Two years before the analysis was done, ICF Consulting also assisted the Postal Service in piloting the use of RFID for container tracking. The pilot test provided hands-on, positive experience with RFID in the postal environment. All things considered, the analysis recommended using RFID for tagging containers.

The hybrid strategy of using RFID for containers and barcodes for handling units leaves a gap in obtaining nesting information at facilities that do not have mechanized material handling for outbound dispatch operations. At facilities using the Robotic Containerization System to load handling units into containers, as was the case during the pilot test in 1998, a manifest is automatically created for each outbound container. The manifest allows the handling units to be implicitly tracked as the container is tracked. At facilities where handling units are manually loaded into containers for outbound dispatch, the nesting information can be gathered by manually scanning the handling units during or after the loading operation, but manual scanning can be very costly. To address this gap, ICF Consulting continues to assist the Postal Service in identifying and testing innovative and cost-effective solutions combining barcodes on handling units and RFID on containers by *thinking*

[†] Containers are tagged with barcodes but their use is limited to inventory control at the Mail Transport Equipment Service Centers.

outside the box. Unconventional use of RFID readers is a key component of these innovative concepts.[‡]

Summary of ICF Consulting's Approach

In summary, ICF Consulting has helped the Postal Service evaluate and select the most appropriate AIDC technology for tagging and tracking handling units and containers. ICF Consulting recommended a strategy that in the short-term combines barcode for handling units and RFID for containers. The strategy recognizes that the cost-effectiveness of RFID will improve in the long run, and RFID will some day become the AIDC of choice for handling units as well. A key element of the strategy is to closely monitor RFID technology so that the timing for adopting RFID can be determined ahead of time and proper planning can be accomplished in a timely fashion.

[‡] Details of the solutions explored are not being disclosed at this time while patents covering these solutions are being filed.