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Recommendations for Automatic Identification Technology in the Air Force Supply Chain

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Introduction

In a white paper published by the Auto-ID Center at the Massachusetts Institute of Technology (MIT), Vivek Agarwal said that, in order to achieve real-time visibility of information, the following are needed:[1]

- Real-time data acquisition methods
- Conversion of acquired data into relevant information using standardized, secure representation
- Instantaneous access to this information

These points could not apply more to the United States Air Force.

All code-reading systems for automatic identification share the following generalized description. There is an item needing to be tracked and its accurate identification throughout the supply chain will be beneficial to the organization. Some form of coding device, such as a label or tag, is affixed to the item so that a wide range of information can be automatically read from the device. The code will be read from the device by any of a number of technologies including an automatic or hand-held bar code reader, optical character reader, magnetic stripe reader, vision system, or radio frequency interrogator. Once the code is read, it will be validated and converted into *system-meaningful* control and information output. The code reader transmits the output to other technologies (computers and so forth) for data manipulation or communication.[2]

Tags and Readers—Radio Frequency Identification

RFID Defined

Radio frequency identification (RFID) uses a radio frequency transmission to identify a person or object. A RFID transponder or tag responds to a radio signal sent by a reader. Tags store information such as a serial number, model number, color, or any other characteristics that may be of benefit. Tags are read by a compatible reader when they pass through its radio frequency field.

Article Acronyms

CIO – Chief Information Officer
DNS - Domain Name System
EPC - Electronic Product Code
JTAV - Joint Total Asset Visibility
MIT - Massachusetts Institute of Technology
NSN - National Stock Numbering
ONS - Object Naming Service
PML - Physical Markup Language
RFID - Radio Frequency Identification

RFID is not a recent discovery. It was first implemented in World War II as a means of identifying friendly aircraft. However, only recently has RFID gained attention as a valuable method of identifying objects on a large scale.

Active Versus Passive RFID

Active RFID and passive RFID technologies are often combined as a whole when referring to RFID; however, they are fundamentally distinct technologies with substantially different capabilities. Effective supply chains do not rely solely on one particular technology, but use both active and passive technologies in complementary ways for complete visibility.[3]

Both active and passive technologies utilize radio frequency energy to communicate between a tag and a reader; however, the technologies differ by the means in which they are powered. Active RFID utilizes an internal power source (battery) for a continuous source of power. Passive RFID utilizes radio frequency energy from the reader to obtain its power. Because passive RFID relies on a reader, a passive tag is only on when it is communicating with a reader.

Applications of Active and Passive RFID to Supply Chain Visibility

Passive RFID is best suited for applications where the movement of materiel is conducted in a highly consistent and controlled environment, and where there is not a need for security or sophisticated data storage or manipulation. Active RFID is more appropriate where materiel flow is dynamic and unconstrained, and where there is a need for enhanced security and data capabilities. Savi Technology outlines some of the main tasks of supply chain visibilities and recommends which RFID technology is best for each.[4] These tasks are outlined in the discussion that follows

Area Monitoring

Active RFID is the only practical technology for area monitoring. Because of the continuous nature of monitoring, only active RFID has the power supply for such applications. Savi Technology suggests active RFID for the following types of area monitoring:[5]

- Collecting real-time inventory information within a warehouse
- Monitoring the location of empty and loaded air cargo containers across an air terminal or tarmac
- Monitoring the security of ocean containers or trailers stored in a yard or terminal

Spot-Level Locating

One means by which RFID enables visibility is by automatically collecting data on materiel as it flows through the processes. In order to accomplish this, readers must be precisely located at specific points within a process. Savi Technology provides the following examples of spot level location: [6]

- Identifying the exact parking slot of vehicles in a truck yard
- Identifying the specific storage rack of a pallet within a distribution center
- Identifying the specific loading bay in current use by an air cargo unit load device

High-Speed, Multi-Tag Portal Capability

A variety of portals can exist in a supply chain. By definition, a portal is any type of doorway, gate, or opening through which materiel flows. Examples may include dock doors at a distribution center, entry or exit gates at an intermodal terminal, and conveyor checkpoints in a parcel sorting operation.

In order for a reader to identify multiple tags flowing through a portal, it must be able to collect information from multiple tags at high speed, while at the same time differentiating between the tags within the specified portal area and those in surrounding areas. Large-scale application, such as roadside monitoring, is available only with active RFID because it has the necessary range. Passive RFID can handle small to medium size portals such as doorways and conveyor checkpoints, but lacks range and can only read tags moving relatively slowly (5 to 10 mph or less). Dual-range active RFID offers the most versatile means of identifying multiple tags through a portal. It is capable of reading tags at a very high speed (greater than 60 mph) and can handle small, medium, and large scale applications.

Cargo Security

RFID can offer cargo security through electronic seals. Both active and passive RFID have their place in security, depending on the application and level of security needed. Passive RFID is only able to detect whether a seal has been broken. The lack of a power source prevents passive RFID tags from being able to continuously monitor the seals and record status throughout the journey. Active RFID is, however, able to continuously monitor cargo and record the date and time of a potential breach and also employ sophisticated *anti-spoofing* techniques to prevent thieves from damaging the integrity of the tag.

Electronic Manifest

Electronic manifests will play an important role in deployment situations. A major concern during Operation Desert Storm was the lack of visibility into Air Force containers. For cargo containers carrying a variety of materiel, it may be necessary to store an electronic manifest within a tag itself so every element of materiel can be automatically updated and checked into a database. Active RFID is the preferred method to store such large amounts of data, and is capable of offering electronic manifest capabilities built into the tag. Passive RFID can only be used to transmit an electronic product code (EPC) number that points to a manifest on an external database.

In addition to the above listed advantages of active RFID, a major advantage is the minimal impact it places on the overall supply chain process compared to passive RFID. Passive RFID will restrict and restrain materiel flow because it has a very short communication range. This could mean materiel movement systems (conveyors) require modification to accommodate the communication range restrictions. In addition, passive RFID has difficulty with multiple tag collection and requires that materiel be adequately spaced so that interference is minimized. Passive RFID may also slow down the materiel movement process since it can only read tags at relatively low speeds. The low cost of passive tags must be compared with the potential time savings of active RFID in the supply chain.

Both active and passive technologies have their place within the Air Force supply chain. Active RFID should be implemented for the most part, but there are specific areas where passive RFID may be used to reduce cost.

Implementation

RFID, combined with an effective database system, will give the Air Force complete visibility into its supply chain. The Air Force will have the ability to locate materiel anywhere in the world in real time.

The Air Force should begin its tagging program at the pallet or container level and work down from there to case tagging, and eventually item tagging. Item tagging will offer the most benefit to the Air Force, but it is the most difficult to implement. Implementing tagging in phases will allow the Air Force to gradually adjust to automatic identification and RFID technology. This will greatly reduce the number of readers that initially need to be installed in the Air Force supply chain infrastructure.

In order for RFID to be fully implemented, all materiel must be tagged. This is best accomplished by the manufacturer in the production stage so that the tag is internal and protected from damage and tampering. The Air Force will need to embark upon a program that gets manufacturers of Air Force products to tag their parts and products during the manufacturing stage. This will be a difficult task since tagging parts will require retooling, and in some cases, require redesigning the part itself. All parts of assemblies and aggregates that need to be explicitly tracked must be tagged.

Readers will have to be distributed throughout the Air Force supply chain and anywhere tags will need to be read. Readers will need to be installed at all warehouse and depot areas. For the monitoring of aircraft, readers should also be placed on the flight line for spot-level locating of specific aircraft.

Codes and Languages

Within the memory chip of the smart tags, an EPC (128-bit code) is embedded for each individual product. As smart tags are scanned by readers, their EPC is transmitted to the Internet where a database stores all of the information for that particular code.

The EPC works together with the Physical Markup Language (PML) and the Object Naming Service (ONS). PML is a standard language for describing physical objects to the Internet analogous to the Hypertext Markup Language, which is the standard language used to display web pages. The ONS is very much like the Internet's current Domain Name System (DNS). The ONS is a computer system that acts as a database, storing all information about any particular EPC, just as the DNS stores the Internet Protocol addresses for all text-based web-site names. The ONS database will probably be significantly larger than the DNS server as it will have to store an EPC number for each object that carries an EPC.[7]

Physical Markup Language (PML)

PML is intended to be a common language for describing physical objects, processes, and environments. It provides a general, standard way of describing the physical world. The

purpose of PML is to provide a language for remote monitoring and control.

PML seeks to provide broad definitions of objects, describing them in terms of characteristics that are common to all physical items. This allows the language to be implemented across multiple industries and applications, rather than one particular focus. PML tries to provide a single representation for a physical object. If there are multiple ways to describe the same object, PML will arbitrarily select one so that data translation occurs when encoding or viewing, not in interpreting what is being viewed.[8]

Electronic Product Code

The EPC was developed as a way to identify all physical objects. The EPC is designed with capacity to enumerate all items that exist in the world, and handle all current and future naming methods. The EPC will be the basis by which to gain database information on a particular item. The EPC will act as a serial number so that the product may be looked up and all of the information known may be accessed. The EPC differs from the current standard, the uniform product code, in that it is able to identify each individual item, not just classes or types of items. The task of enumerating all these is daunting, and requires a code that has a tremendous amount of capacity.

Implementation

It is recommended that the Air Force adopt the Auto-ID Center's EPC for identifying individual items. This 128-bit code has the capacity to handle each individual item of Air Force materiel and not just classes or types of items. The EPC would allow the Air Force to track a particular part for a particular plane throughout its life and log its use and repair history. The EPC would not replace the current National Stock Numbering (NSN) System implemented by the Air Force. The NSN would still be needed to identify classes and types of products. An EPC should be automatically generated by the database for every individual item the Air Force wishes to track or monitor. It is also recommended that the Air Force adopt the PML developed by the Auto-ID Center. PML is the link between the EPC and the ONS.

Databases

The Air Force should phase out all of its subsidiary databases that serve various niches of the Air Force and replace them with a single, all-purpose database that every user can access from anywhere in the world. Meeting this second requirement suggests that the database should be Internet-based and have the capability of tracking all types of assets.

The Joint Total Asset Visibility (JTAV) 2020 initiative suggests a common database that is fed data at predetermined intervals from one of the many subsidiary databases that currently exist. It would prove much more efficient if the primary database were developed with the capability to perform all Air Force supply chain tasks so that personnel at the beginning of the chain can use it to enter data and retrieve information. Under the current JTAV initiative, the burden would still be on the user of the supply chain to choose which system to update based on the particular piece of material. Furthermore, none of the existing databases currently have the capability of tracking individual parts, only classes or types of items. The Air Force should have a single database that may be accessed by any user via the Internet. This would eliminate the need to have specialized terminals with dedicated communication lines such as those required by the Standard Base Supply System or special software as required by the Mission Capable Asset Sourcing System. The user would only need a PC with an Internet connection that would connect directly with the master database located on remote servers.

This database would necessitate an extraordinary amount of data storage. Capacity would be measured in terabytes not gigabytes. This database would have to accommodate the specifications and history log of every individual item the Air Force possesses.

The database should be located on a secure server with substantial firewall protection. Access to the database should be allowed only with a user ID and a password. Different levels of security should be allotted to Air Force personnel based on what information each particular person needs to access.

Deciding on Standards

Standards for RFID have been slow to develop over the years. The International Standards Organization, the Uniform Code Council and the Auto-ID centers at MIT and Cambridge University are among the parties developing standards.

There are several initial steps the Air Force and military in general must undertake in order to embark upon the challenge of total-asset visibility. The first is choosing standards. Standards must be chosen on several levels—from what RFID frequencies to use, to what serial number methodology to use in identifying products, to what type of database and computer platform to use for a consolidated database. The Air Force is a large enough entity that it could form its own standard or the DoD could form its own standard separate from commercial industry. The Air Force, and the DoD in general, uses a lot of proprietary products and has its own infrastructure. With this in mind, separate Air Force standards would not create a large problem because its supply chain is a closed system with regard to military-specific items.

Wal-Mart as a Model

Wal-Mart is always on the forefront of emerging technology and, because of its dominating position in the market, has the ability to enforce any implementations it wishes to impose. In June of 2003, Wal-Mart set the date of January 2005 for RFID implementation.[9] This meant that by that date, the top 100 suppliers had to work with Wal-Mart by using RFID to track pallets of goods throughout its supply chain. Linda Dillman, Wal-Mart's CIO, noted that "At some point, like any other technology, like EDI, it'll be a requirement for doing business with Wal-Mart."[10] The Air Force, as with Wal-Mart, has the force in the market place to make these kinds of demands on its suppliers.

Conclusions

In this article we reviewed much of the current technology for improving supply chain visibility and made recommendations as to how this technology might be implemented within the Air Force in order to support its JTAV 2020 initiative. Implementing such an overhaul of the supply chain and incorporating cutting-

edge technology cannot be done overnight but will probably take decades to complete. Gradual, step-by-step, implementation will be necessary to ensure a smooth transition.

Notes

1. Vivek Agarwal, "Assessing the benefits of Auto-ID Technology in the Consumer Goods Industry," Auto-ID Center, Cambridge, United Kingdom, 00.
2. *Ibid.*
3. Savi Technology, "Active and Passive RFID: Two Distinct, But Complementary, Technologies for Real-Time Supply Chain Visibility," [Online] Available: www.savi.com, (accessed Oct 02).
4. *Ibid.*
5. Savi Technology, "Active RFID: Selecting the Optimal Frequency for Global Applications," [Online] Available: www.savi.com, (accessed Oct 02).
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7. D.L. Brock, T.P. Milne, Y.Y. King, B. Lewis, "The Physical Markup Language: Core Components: Time and Place," MIT Auto-ID Center, Cambridge, Massachusetts, 01.
8. *Ibid.*
9. C. Murphy, M. Hayes, "TAGLINE: Wal-Mart Put a Date on RFID Implementation: January 2005. Will Suppliers and the Technology be Ready?" *Information Week,* 16 Jun 03.
10. *Ibid.*

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AF/A9 Logistics Analysis: Setting the Gold Standard

Major Andrew Hunt, USAF

Quick quiz. Do you know what organization provides top-notch operational analyses to the Air Force's senior leaders? Those of you that said the Air Force Studies and Analyses Agency (AFSAA) *would* have been right. Prior to 1 February 2006, AFSAA set the gold standard for Department of Defense analysis. And after 1 February? Well, only the name has changed. As part of the Headquarters realignment to the A-Staff construct, AFSAA (a former direct reporting unit) has merged with the Office of Lessons Learned to form HQ USAF/A9, the Studies & Analyses, Assessments and Lessons Learned Directorate. A9 is still charged with delivering fireproof analyses to the Air Force's *Top IV* (including the Secretary of the Air Force, the Chief of Staff, Air Force, and the Vice Chief of Staff, Air Force). We think we do a pretty good job, and others agree.

So, what does this have to do with logistics? A9 has a select group of forward-thinking loggies that sit in a very unique position. We are charged with ensuring that key logistics feasibility and supportability issues are addressed when conducting operationally focused studies and analyses. For example, if a study is looking at an increase in tankers for a particular warfighting scenario, it is our charge to provide the analysts with tanker basing options that not only address operational considerations, but also incorporate a base's existing and projected logistics support capabilities. These considerations, in the opinion of many, have been missing from such studies for some time. The bottom line is that A9's logistics analysts are doing our part to ensure that the issue of logistics is not *magic wanded* away.

The future of the logistics efforts at A9 is growing brighter everyday. Our team now consists of a mix of supply, fuels, logistics plans, and maintenance expertise. We are continuously seeking to establish or expand partnering relationships with the Headquarters Air Force A4/7 directorate, major command logistics analyses operations, and the Air Force Logistics Management Agency. We constantly keep our ears to the ground so that we can stay on top of current issues in Air Force logistics. Our goal is to continue to find ways to bring the weight of logistics to the analyses that will shape our Air Force in the future.

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