



RFID Handbook
The Future of Asset Management
and Auto-ID Technology





The Future of Asset Management and Auto-ID Technology

Assets are the cornerstone of your business. Without them, what do you have to offer? If you struggle to answer that question, then asset management and tracking are vital to the success of your company.

Properly tracking your assets and keeping track of where they are in the supply chain will help you control your company's operations more efficiently. Asset management offers many benefits for modern businesses, including:



Eliminating unnecessary costs



Preventing product loss



Ensuring timely deliveries



Improving supply chain efficiency, productivity and accuracy

To capitalize on these benefits, it's best to move beyond manual tracking and invest in auto-ID technology. The most common type is the humble barcode, but there's another, more high-tech means of asset management that is gaining more traction by the day: RFID technology.

In this handbook, we'll detail out just what RFID is and how it might be able to help improve your company's operations.

RFID: What is It, and How Does it Work?

Radio Frequency Identification, or RFID, refers to a technology where information is transmitted wirelessly over radio waves. With early iterations becoming commercially available in the 1970s, RFID technology allows users to automatically track and identify assets and inventory.

Not only are RFID systems contactless, but they also do not require line of sight like other auto-ID technologies. For different applications spanning various industries, RFID technologies offer a long-term and durable solution for better asset management and tracking.

RFID systems are made up of three main components: tags, readers and middleware.

Tags are essentially small memory banks, storing bits of valuable information that can be used for asset management and a variety of other purposes. They use radio waves to communicate with nearby readers, sending over portions of identifying data. The information stored in RFID tags can range anywhere from a single serial number to multiple pages of data.

Readers, on the other hand, are basically the other end of the information exchange. They are what we use to take those radio waves from the tags and translate them back into useful data. Readers are devices with one or more antennas that can emit their own radio waves and scan the signals of any RFID tags within range.

RFID readers offer some versatility depending on the needs of your application. You can have mobile readers that you can carry around in your hand to scan tags, or they can be mounted in a single location to scan tags that enter their proximity. Readers can even be built into existing architecture like a cabinet or doorway.

Middleware serves as the essential interface between the reader and your company databases and information management software. Not only does middleware handle communication between the reader and your existing systems, but it also helps to filter, aggregate and interpret all of that data coming from the RFID tags.

Different RFID Frequencies

RFID systems can vary in performance based on their frequency. There are three main frequency ranges for standard RFID systems: low frequency, high frequency and ultra-high frequency.

Low Frequency

RFIDs that transmit in low frequencies are the simplest and most basic option available. Low-frequency options can range anywhere from 30 to 300 KHz, with very short read ranges – often only a couple of centimeters – and limited data transmission. These frequencies are typically used in applications such as animal tracking for livestock and simple access control.

High Frequency

Most RFID systems operating in a high-frequency range will come in at 13.56 MHz, though they can range anywhere from 3 to 30 MHz. 13.56 MHz is the standard frequency due to the near-field communication, or NFC, protocol, which was approved by the International Organization of Standardization, or ISO.

High-frequency RFID systems have a somewhat greater read range than low-frequency transmissions – up to about a meter – and have larger memory options. These systems are becoming more and more popular in marketing and interactive experiences, as well as critical access control and data transfer applications.

Ultra-High Frequency

Ultra-high frequency RFID systems can range anywhere from 300 MHz to 3000 MHz and offer the most complex and high-performing capabilities of the different frequency ranges. They have the greatest read ranges, which are largely dependent on the type of tag used.

RFID Tagging

In the ultra-high frequency subset of RFID systems, you have three different types of RFID: active, passive and semi-active. This mainly has to do with the style of the tag.

Active Tags

Active RFID tags are the most complex of the different types of tags. They are powered by their own batteries and have an integrated circuit, antenna and onboard transmitter.

With their own battery, active tags can support additional features and functionality, such as integrated sensors or increased memory and logic. The onboard transmitter also allows these tags to work over greater distances. They allow the tags to send energy directly to the reader rather than just reflecting back energy that the reader transmitted to the tag, thus increasing the read range.

The cost of this added functionality is that active RFID tags take up more space than their passive or semi-active counterparts. Active tags also literally just cost more. Since they are battery-operated, you can expect these tags to have shorter lifespans as well. As such, active tags are often too cost-inefficient and overly complex for most operations.

Passive Tags

Unlike active tags, passive RFID tags are typically comprised of only an integrated circuit and an antenna. They do not have a battery and must instead be powered by the reader through inductive coupling when dealing with high frequencies, or through backscatter if you're working with ultra-high frequencies.

Since they don't have their own battery, passive tags can only "run" when needed, leading to energy savings and extending their lifespan. It's also easier to reprogram passive tags, leaving the serial number the same and changing whatever data you need to alter on the backend. They're also easier to incorporate into your operations with the help of an RFID expert.

However, that simplicity does carry over into function as well. Passive tags don't have the increased read ranges of active tags or the ability to add on as many bells and whistles. This makes passive tags the perfect choice for most applications that only require intermittent check-ins at certain points, but not a great choice for more demanding applications that require constant tracking in real-time.

Semi-Active Tags

Semi-active RFID tags, also sometimes called semi-passive tags, are a bit of a compromise between the two. They are made up of an integrated circuit, an antenna and a battery.

By having their own battery, semi-active tags allow for the additional device functionality like active tags, including sound notifications or real-time tracking. However, without an onboard transmitter, they gain no benefit in terms of read range, and their battery puts them in the same category as active tags for their decreased lifespan.



Top RFID Considerations: Why do I Need RFID for My Application?

Choosing to go with RFID technology over manual asset management or other auto-ID technologies comes down to **performance, efficiency and reliability**. Here are the top reasons why RFID may be right for you.

Higher ROIs

For many applications and use cases, RFID implementation can lead to a significant ROI. This is, of course, dependent on the specific needs of your application.

Environmental constraints, asset compositions and read range limitations/requirements can all impact how effective – and thus cost-efficient – an RFID system is for your application. While RFID is considered the latest and greatest evolution in asset management, it just may not be right for every application, especially if you're expecting a certain ROI in a specific time window.

That's why Metalcraft has the DART™ Qualification Process, to ensure that RFID is the right choice for a specific operation and that expectations are clear from the very beginning. By defining what you want to accomplish and your expected outcome, then comparing that to the requirements of your system, Metalcraft can make sure that you make the right choice.

Fast Tracking and Better Asset Management

One of the biggest operational benefits of RFID technology is the ability to read multiple tags at once. Rather than having to scan each barcode individually, taking the time to line the label up with the scanner, RFID works on proximity, allowing you to read a case lot of containers or pallets in a fraction of the time.

By instantly detecting assets upon arrival and pairing them with information in your database, RFID systems can better manage your assets than ever before. With RFID, you can easily cross-reference your inventory against assigned locations – both stationary and mobile – to see if certain assets are present, missing or in transit. This allows you to not only make sure that everything is running on schedule, but also pinpoint where an asset was lost if anything goes missing.

Reduced Human Error and Labor

With the automatic nature of RFID systems, human error is almost entirely eliminated. So long as the tags are within range of the reader, and there is no outside interference from the environment, RFID technology reliability tracks your assets every time.

RFID-enabled asset management also requires far less labor than manual or barcode-only checks. Especially with higher-end tags and fixed readers, RFID asset management is the closest thing to a fully automated tracking solution.

Easy Integration and Upgrades

RFID can work with many existing systems, allowing you to easily integrate RFID systems into your supply chain. You can also choose to adopt RFID technology at certain locations to begin with, then add on additional locations at your own pace.

Data Redundancy

While RFID offers benefits beyond barcodes and typical auto-ID technologies, it's usually not an either-or scenario. In fact, using both barcodes and RFID systems in your asset management can help with data redundancy.

Once you have an RFID system set up, minimal investment is needed to add a barcode to an RFID tag. If you're tracking mobile assets moving between facilities, barcodes can act as redundant technology, allowing you to read tags in an open-source system wherever there is no RFID-supported infrastructure. Having the barcode information programmed into the RFID chip can also add extra redundancy for peace of mind.

The Bottom Line

Even beyond data redundancy, barcodes can still be powerful tools in the pursuit of better asset management. While they lack many of the more industrious and attractive qualities of RFID, their tried-and-true nature still has benefits for many applications, sometimes even in place of RFID.

Surface composition doesn't matter when it comes to barcodes. They can be designed for curved surfaces without negatively impacting their performance, while these types of surfaces can impact the read range of an RFID tag. Metal surfaces and liquid-filled containers can also present challenges for RFID tags as they disrupt RF waves, but they have no impact on barcode functionality.

Barcodes take less time to implement than RFID, meaning that you can start improving your asset management much faster. If time is of the essence or you're eager to get to a solution sooner, you may want to start with barcodes and stagger your RFID implementation until you have a fully-integrated asset management procedure with redundant barcode and RFID systems. Of course, if all you need is very basic asset management, barcodes may be the best and most cost-efficient choice. The best asset management solution is not simply the most complex one available, but rather one that meets your specific identification needs.



Industry Verticals: Where is RFID Today, and Where is it Going?

While a variety of applications can benefit from RFID technology, there are a few main industry verticals experiencing a lot of success and potential for growth. These industries are manufacturing, medical, education, government and warehousing/distribution.



Manufacturing



For modern manufacturing processes, product traceability and accuracy are critical. Companies are facing increased pressure to streamline their manufacturing processes to ensure accurate and on-time product deliveries.

When inventory management is left up to manual reporting, it slows down delivery and leads to lost or mishandled product. It simply isn't efficient for an employee to stop what they're doing, log into a computer and slowly report out on a batch of product. This can easily take around 10 minutes per product, per assembly line. It's also far more likely with manual transcripts to report in a wrong operation or incorrect job, report an operation twice, or even skip over a report entirely.

This can create ripple effects across the entire supply chain, impacting inventory quantities and leading to shortages. That means spending more time and money on ordering replacement inventory and rushing jobs.

With RFID-enabled asset management, you can auto-fill tracking information quickly on arrival without the need for any human intervention. This can theoretically happen at as many locations as you need per the application. By auto-filling information and delivery statuses, RFID eliminates both the labor requirements and human error possibilities of other forms of tracking while increasing production visibility and inventory accuracy.

Medical



As one of the most heavily regulated industries, healthcare requires a strict level of asset management to maintain regulatory compliance and support patient outcomes. Many hospital assets such as wheelchairs, diagnostic equipment and pumps need to be located quickly for vital patient care. Not to mention that they are often loaned from one facility to another. And, staff audits via barcode scanning are often infrequent and time-consuming, causing these assets to frequently go unaccounted for.

With passive RFID readers at key points throughout a facility, hospital staff can keep tabs on where critical equipment is located at all times. Then, handheld RFID readers can be used by staff to quickly go from room to room to capture exactly where those assets are if needed.

Another big thing for the medical and pharmaceutical industries is preventing theft, as well as counterfeit products. RFID systems can easily keep track of where drugs and medical equipment are at along their delivery routes. Then, when the items arrive, you can verify that they are indeed the real deal through RFID tags and inspecting to see if any tampering occurred.

Industry Verticals (continued)

Education



Schools, especially college campuses, often have a large number of assets spread across multiple facilities. Some institutions even have campus locations many kilometers apart, with high-value technology frequently going back and forth between them.

If you're to only rely on barcodes alone, that means constantly crawling over desks and climbing ladders to keep tabs on countless fixed and mobile assets. It's no wonder that colleges typically take months or more to do a full inventory check.

However, with a handheld RFID reader, what would have taken half an hour or more to track the assets in a computer lab can be done in a one-minute walk-through. Assets can also be tied to specific buildings or rooms, notifying staff if they are taken out of range.

Not only can RFID technology help to keep campus assets in check, but it can also help maximize their use. You can only use a shared laptop or tablet when you know where it is. This also helps to prevent schools from needlessly ordering more supplies or, on the other hand, waiting too long to order them. Either way, it helps to keep school budgets in line and on target.

Government



When it comes to the government, security is of the utmost importance.

Whether it's technology containing classified information or property equipment, many government assets must be tracked and monitored at all times.

In these situations, barcodes only work in a reactive sense. You might be able to set off an alarm or notify staff if an item isn't checked in within a certain time window, but a barcode isn't going to do anything if someone puts the asset in their suitcase and heads out the door.

Only with RFID tags and readers can you see exactly when an asset is no longer where it should be. Even when not dealing with sensitive assets, RFID-enabled tracking can help to hold departments accountable for a lost item. Active RFID systems can be especially useful here, as they have the battery power for additional sensors, alarms and other add-ons that can help maintain security.

While not always directly government-owned, the same thing can be said for museums. Keeping tabs on priceless art and relics of natural history is worth its weight in gold to many.

Warehousing/Distribution



Asset management is vital to the warehousing and distribution industry, likely more than any other industry here. That's because keeping track of inventory and sending products to the right locations is the core of what this industry is all about.

In addition to being able to better manage one-off inventories of consumer goods, what's more important is the reusable nature of RFID technologies for pallets and barrels. These items may be used for multiple years to ship products back and forth.

Durable and reusable RFID tags offer great benefits here. RFID tags are often built to withstand years of use, even in hot and dirty delivery environments. Automating the QA process on load verification also helps to minimize missed deliveries to convenience stores, which is a problem that costs distribution companies \$25-30 million per year nationwide.

The Benefits of Custom RFID Systems

The only thing better than an RFID system is a custom RFID system. Like most technologies, there is no such thing as “one size fits all” when it comes to RFID. In order to best optimize inventory accuracy and logistics processes, RFID systems should be tailored to meet the unique needs of your application.

The size of the tag, its read range and its ability to work on the specific surface of an asset must all be taken into account when specifying an RFID tag. The frequency range is also important, as it will determine the capabilities of your RFID system. Beyond choosing from different frequencies and tag types, here are some additional ways to tailor your RFID system to better work for you:

On-Metal Tags



Typically, putting an RFID tag on a metal surface can lead to problems. Metal can reflect RF waves and alter a tag's frequency by detuning the tag's antenna. If the frequency changes, the tag may no longer be able to communicate with the reader, even if it tries to send out information.

On a basic level, the flow of information between RFID tags and readers works similarly to two-way radios or walkie talkies. If you're not on the same frequency, all you'll get is static.

However, some providers can design specialty RFID tags that are meant for metal surfaces. On-metal tags may include a thin layer of foam or extra insulation that keeps the metal antenna of the tag from touching the metal surface of the asset. These specialty on-metal tags can also offer benefits with read ranges, allowing the tag to reflect back a stronger signal that could be read from further away.

The Importance of Adhesives

No matter what type of item you're tagging, whether it's metal, plastic or cardboard, you need the right adhesive to make sure that your label will stay put no matter what happens to it in transit. Heat, dust, rough handling – all of these things can ruin or strip off a tag without the right adhesive. When the label fails, asset management goes out the door.

The important things here is to match the adhesive to the type of surface you need it to stick to. Surfaces that are oily, rough or painted will need special attention, but even bare metal surfaces require the right adhesive if you want to make sure that label isn't going anywhere.

Most adhesives are pressure-sensitive adhesive. Here, the adhesive is almost like a sticker, where you peel off the backing and then stick the tag on the asset. This allows RFIDs to be easily placed and then later removed from an item. Metalcraft works with a wide variety of pressure-sensitive adhesives, whether you need one with a rubber base, an extra-strong surface bond, low/high surface energy or an acrylic design. No matter your application, the experts at Metalcraft can recommend the best adhesive for the job.

For more permanent and durable tagging, bonding the tag to the item can help. This can be done with a number of different adhesives, including cyanoacrylate, structural acrylic and epoxy. Cyanoacrylate has a very fast cure, often bonded to the asset in a matter of seconds. Structural acrylic adhesives also offer a relatively fast cure, coupled with high peel strength and environmental resistance. If you need better water and chemical resistance, epoxy adhesives are the go-to choice.



The Benefits of Custom RFID Systems (continued)

Custom Programming



The programming of your RFID system sets up how it functions and what it can do. Custom programming can include the schedule for bulk updates, regular inventory reconciliation, location triggering rules and more.

The specific information that's shared between the tag and the reader is also important. While certain RFID systems can offer tags that send out pages of information, here at Metalcraft, we always advise only sending over the information that you need to. Less is often more. No matter how much information you want to send, you'll want to choose an RFID infrastructure that can best accommodate that flow of data.

Additional Security Features



Adding a tag to your item can add a significant amount of security to your operations. Tags can show when something has been tampered with, as well as help you to track who's had their hands on the item and where it's been.

For added security, Metalcraft's DuraDestruct RFID security tag offers an extra layer of protection. The specialized construction of this tag combines the durability of your standard RFID label with destructible features that render it useless if someone tried to remove the tag or otherwise tamper with it.

Beyond the tag itself, there are a number of different ways to beef up the security of an RFID system. This can include both additional functionality in active systems, as well as strategic designs and tag placement that can affect passive systems as well.

Strategically placed security slits are a simple but effective way to improve RFID security. Used independently or combined with a destructible material, security slits not only still provide the primary tracking function but also help to deter theft and unauthorized removal by designing the slits right into the RFID inlay.



Future Trends

Since RFID is on the cutting edge of auto-ID technology, there are always new trends, features and applications continuously pushing RFID even further. Here's what to look out for:

Touchless Payments



You've probably seen "smart stores" in the news recently. Rather than items having a barcode that needs to be scanned individually, with RFID tags, customers can simply walk through a scanner and checkout in seconds rather than minutes. Anyone who's ever worked as a cashier or used the self-checkout line at a grocery store can attest to how long barcodes take to scan.

This idea goes beyond retail stores and the consumer market. Any industry that is selling a product can benefit from RFID tags, instantly tracking when an item leaves the warehouse, letting you deliver batches of product at once in a fraction of the time.

Additional Sensors



If you're looking for more than just standard inventory tracking, companies are finding new and creative ways to apply additional sensors to their RFID tags. These can replace or add redundancy to already-established systems, or even create new functionalities that only a sensor on the tag itself can offer. This is especially true for active RFID systems and continuous tracking.

New sensors can monitor a number of things beyond asset location, including temperature, moisture, and any significant shock/impact. All of this information allows you to conduct better maintenance and preventive care for your assets, noting any problems exactly where and when they happen. Want to know where in your supply chain packages are constantly suffering water damage? The right sensor will tell you.

Access Control



RFID key fobs, wristbands and windshield tags are becoming increasingly popular in both the consumer and private space. Simply give a person or a vehicle a wearable authorized RFID tag, and you can control their access to a certain location.

Sometimes the data on a tag can also be sensitive or proprietary, making it a concern of who has access to that data. While Metalcraft advises limiting the information stored on the tag for security purposes, increased encryptions and specialized frequencies can help better control the flow of information.



Visibility of your assets today EMPOWERS you tomorrow

When it comes to tracking assets, idtracon specializes in offering a complete solution for total asset management. With our team’s mix of RFID expertise and traditional labeling experience, idtracon will help you get your assets where they need to go, whether that’s through RFID or barcodes, or a mix of both.

Every time we’re specifying a new solution, we use our deep product and technical knowledge to help customers solve their toughest asset management challenges, making sure to tailor our offerings to their specific needs.

Once we’ve worked with you to identify the right solution, our wide breadth of standard product offerings can be customized to meet the task at hand. We offer the most durable, technology-agnostic solutions coupled with an unmatched selection of adhesives. What good is an RFID tag if it doesn’t stick to the asset that it’s meant to track?

We also offer custom printing and a better selection of traditional labels for all of your barcode needs. Both our barcode labels and RFID tags offer the greatest durability, accuracy and reliability in the industry. Our tags stay around for the long haul, and after seeing their enhanced functionality and reliability, you’ll find that our solutions do too.

Our team takes the time to actually learn about your business and needs so that we can develop the right solution – no matter the technology.



That’s why idtracon is confident that we can deliver a label made better for any application. That way, you can keep your assets – **and your business** – on track for success.



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