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Six Steps to a Successful RFID Asset-Tracking System

How to Set Up an Asset-Tracking System Using Radio Frequency Identification (RFID)

White Paper

Abstract

While advanced automation has helped to vastly streamline industrial production in past years, RFID asset-tracking systems have done the same with inventory management and logistics. This paper provides a brief history of RFID as well as an overview of how it works and common applications. It then covers the six most basic steps required to successfully deploy an RFID asset-tracking system, along with appropriate caveats. Ultimately the keys to success are careful planning, followed by good RF engineering, project execution, stakeholder communications and user training. A qualified RFID systems integrator can help reduce deployment time and risk, while improving how quickly a return on investment can be achieved.

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A white paper issued by: Siemens.

Putting the "Internet of Things" to work in your business

It's not news that today's factories and supply chains are vastly more efficient than they were even a decade ago. One reason, of course, is advanced automation. But another is Radio Frequency Identification, or RFID for short.

RFID has helped manufacturers, their suppliers and the logistics companies serving them both to improve how they track their various physical assets, whether feeder-stock inventories, work-in-progress, finished goods or goods-in-transit. They also use RFID to track tools and equipment.

With RFID, companies can obtain precise, up-to-the minute information about the locations and movements of their assets. The more accurately a business knows the whereabouts and status of its assets, the more it can maximize their utilization and return on the capital invested in them.

Things talking to things. To a great extent, RFID has enabled what's called the "Internet of Things." Kevin Ashton, a co-founder of the Auto-ID Center at the Massachusetts Institute of Technology (MIT), coined the phrase to describe a world in which physical objects, in effect, talk to each other:

> *"If we had computers that knew everything there was to know about things – using data they gathered without any help from us – we would be able to track and count everything, and greatly reduce waste, loss and cost. We would know when things needed replacing, repairing or recalling, and whether they were fresh or past their best."* [1]

Thanks to continued advances in RFID's underlying technologies – chip densities, cloud computing, wireless communications, IPv6 and data management, among them – Ashton's vision has become a reality for many companies around the world and across just about every industry.

With RFID, they have successfully driven out of their business models enormous amounts of time, variability, errors and cost. This has given them much greater operational visibility and asset utilization. In turn, they've realized huge improvements in speed, quality and profitability.

Yet for all of RFID's benefits and success stories, many companies have yet to take advantage of this revolutionary technology. If yours is one of them, this paper will offer you guidance about how you can deploy RFID successfully in your operations.

RFID: A brief history and how it works

RFID's roots go back to early radio frequency (RF) transponder technology, born in World War II, that enabled radio waves to energize a resonator over air at a distance. In the 1970s, passive radio transponders were introduced that foreshadowed many RFID uses today.

Those applications include electronic toll collection and vehicle identification applications, automatic gates and various security uses, including personnel identification. Even Disney World uses RFID in its wrist bands to identify its guests – and to let them pay for food and souvenirs.

In the late 1990s, the U.S. Department of Defense and large companies like Walmart and Proctor & Gamble helped spur industrial adoption of RFID. Not only were they using it in their operations, but they also expected their suppliers to start doing so, too. In 2003, the technology got a huge boost when MIT's Auto-ID Center, backed by a global consortium of more than 100 universities and large corporations, introduced the Electronic Product Code (EPC). The EPC defined a set of open standards for universally accepted identifiers to be used by RFID systems.

How RFID works. Simply put, in industrial applications, an RFID system starts with a small electronic tag with a radio antenna and chip aboard that is placed on an item, case of items or pallet of cases. Tags feature a unique 64- or 96-bit EPC identifier – a "license plate" of sorts – programmed into the chip. They can be affixed during an item's production or placed at any later point as it moves through the supply chain.

When an item, carton or pallet with an RFID tag passes through a verification point, an RF "reader" will sense the tag's EPC if it's an active, battery-powered tag. If not, the reader will emit RF waves to induce a current in the antenna of a passive, non-battery tag. Either way, the EPC is read and sent to a database containing an asset's record. The record can be updated with information such as:

- The type of asset and its date of manufacture;
- Where the asset came from and where it's going;
- The times at which the asset was moved;
- Who was responsible for moving the asset.

Importantly, no line of sight is needed to read the EPC, as in the case of traditional barcode labels. That enables items within a case and on pallets to be identified as they move through an RFID reader's RF field without opening the carton or pallet.

1 Kevin Aston, "That 'Internet of Things' Thing," RFID Journal. June 22,2009. (http://www.rfidjournal.com/articles/view?4986)

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Doors and floors. Typical placements for RFID readers include the doors and floors of factories, warehouses, shipping and receiving docks, retail back rooms, even store shelves in some cases. In some applications, RFID tags are also being used as part of full-circle resource recovery efforts, especially for goods containing valuable or highly sensitive components that can be reused, recycled or need to be tracked for security reasons.

RFID readers are necessarily networked. That's because the EPC data they gather needs to flow into some kind of a company databases, where an asset's status is updated. Examples of the kinds of information that an RFID system can provide about an asset include:

While RFID data will typically stream into databases of some kind, it can also be used by manufacturing execution systems (MES) as well as higher-level enterprise resource planning (ERP) systems. The former will capture the data into historical records to track assets; the latter can use the data to trigger other production or warehousing operations, like restocking low inventories.

Types of RFID applications

RFID-based asset management can have important business benefits in such areas as:

Stock availability.
The constant automatic updating of information enables a system to trigger a warning as soon as stock levels reach a minimum threshold. Company personnel can then submit replenishment orders immediately.

Security and shrinkage.
RFID tags can record whether packaging has been tampered with, as well as the locations of assets. This enables companies to reduce or prevent theft and other causes of inventory loss, such as product diversions.

Documentation management.
RFID systems can automate the processes of updating the delivery, receipt and reconciliation of documents. This can help a company identify and analyze potential problems, speeding up the order-to-delivery cycle.

Shelf-life management.
RFID systems make it easier to identify the age of time-sensitive products, helping to manage these products better. Older products can be placed nearer to the front of shelves, for example.

Inventory management.
RFID systems can reduce the potential for human error in stock-taking and eliminate the need to scan individual barcodes. This prevents inaccurate data capture and reduces warehouse cycle times.

Management of defects and recalls.
You can use RFID information to determine where defects occur in the product cycle and to identify individual products that need to be recalled.

Distribution: By enabling companies to track the locations of assets, RFID systems enable faster, more accurate distribution of products – to warehouses or retail outlets, for example. You can analyze RFID-generated information to track product sales velocities, locate bottlenecks in the distribution chain, and improve other business processes that can impact product delivery cycles.

Six steps to a successful RFID asset-tracking system

Although RFID is used in a wide variety of applications, one of the most common is asset-tracking. To deploy such a system, it's critical to plan and develop the required technological infrastructure. You also need to determine the best way to integrate RFID data in your existing data management system. That requires business rules that dictate how the RFID data must be used. Finally, once you've deployed your system, you should continue to refine both it and its associated business processes to optimize the value of your RFID asset data.

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1. Business case development and priortization
2. Business process and workflow mapping
3. Site assessment
4. Architecture Development and Component Sourcing
5. Installation, tuning and testing
6. Communications and training

Implementing an RFID-based asset management system requires a significant investment of money, time and effort. However, the value of a carefully planned RFID-based system may far outweigh its costs. The following six steps will help you ensure a successful RFID asset-tracking system implementation in your business:

1. Business case development and prioritization

To maximize the benefits from deploying an RFID system, you need to identify which of your company's existing processes the system may improve and the potential value of these improvements. Once you've done this, you can determine whether an investment in the use of RFID is justified and plan its implementation effectively.

Assuming the benefits will justify your RFID investment, you should then prioritize your application of the technology. Try not to tag and track everything, tempting as that might be, but start small. Target the most problematic assets for tracking. Examples include ones that are of high value and subject to theft or loss; ones that take a lot of time and effort to track; or ones that are subject to a lot of tracking errors.

One important consideration at this stage is finding and hiring a qualified RFID systems integrator. Most companies don't have the in-house resources, even among their IT staffs, to expertly plan, design, engineer (especially the RF engineering), install and commission a RFID asset tracking system. The investment in outside experience and expertise will pay for itself in faster and less risky deployments. The Siemens Solution Partner Network can help you find qualified candidates. The successful candidate can help you with the following steps.

2. Business process and workflow mapping

After determining the target application for your RFID system, the next step is to carefully examine and map out every step in the process. Determine what asset item is to be tracked, its movements through your facility and what organizational functions will have a stake in knowing its status and whereabouts. Also determine who will be the system's users and who will own the data.

This stage in an RFID system implementation is a great opportunity to find ways to streamline a process and remove outdated, low-value steps in the process, especially manual steps involving paperwork. It's also a chance to apply standardized business practices where needed.

As is the case with automation, too often companies fail to adequately understand the processes that underlie a problem they are trying to solve. Later they learn that applying technology didn't fix the problem, despite all the money, time and effort that were expended.

3. Site Assessment

A thorough site assessment should have three goals:
1. To understand the context of where it will be deployed;
2. To gather the information needed to define the deployment requirements; and
3. To predict the performance of the RFID solution to those requirements.

Wherever you plan to install RFID, for example, it's important to survey the site's existing RF "landscape." Interference from wireless networks (your own or from neighboring businesses) as well as short-range radios, cordless phones and other RF sources can dramatically and negatively affect RFID system performance. Keep in mind that interference can come from behind walls, around corners and through ceilings.

Due to their reflectivity, metal fixtures and shelving that are especially typical of warehouse environments can affect RF engineering. Some sites may also have certain mechanical and environmental requirements. Will there be vibration? Will harsh chemical conditions or temperature extremes affect tags or readers? What's the potential for normal operations to damage the equipment?

Next, draft a floor plan that shows the locations of all fixtures, shelving and other fixed objects. Determine the work flow through each area of a facility that will be subject to the RFID deployment. Will fork lifts, pallet lifts or pallet scissor lifts be used? Other vehicles? What paths will they take? It's a good idea to photograph and document the environment from multiple angles and tie those views into the floor plan, if not use them to create elevation diagrams.

A careful evaluation and documentation of the RF environment by a site survey early in an implementation is critically important to guiding equipment selection

and installation. It also will help set realistic performance expectations among the various stakeholders of an RFID system, especially the workers who will have to use it and the management executives who will have authorized the investment in it.

4. Architecture Development and Component Sourcing

After conducting the preceding steps, various requirements of the RFID system's architecture will have asserted themselves – what assets need tracking; where they come from and where they go; the process by which they move around; where RFID readers will be placed and others. It's important to capture all this information in a version-controlled statement of requirements and in an architectural plan. Your overall system architecture should be scalable, to accommodate an expanded scope of requirements after deployment. It also should be capable of being upgraded with new, more advanced technology over time (i.e., "future-proofing").

From this document you will develop a bill of materials. This will include the types of tags you need to track your assets, plus readers, cabling, interconnects, servers, if required, and any so-called middleware your system needs to communicate with a tracking database, other internal operational systems and IT platforms such as a customer relationship management (CRM) system.

Your system components can come from any number of suppliers and, given the EPC's open standards as well as the much greater interoperability of most components available today. However, while you want to avoid any vendors that would impose a locked-in proprietary solution on your business, you can gain considerable value – both short- and long-term – in single-sourcing from one supplier.

Generally the components will integrate more easily, making deployment easier and faster. Spare parts, service and support are also easier to manage, if all come from one supplier. Just be sure the supplier has the financial strength and resources to be around for at least the anticipated life span of your RFID system.

Here are some considerations to make about your RFID system's core components:

Tag Types and Placement
No universal, one-size-fits-all tags exist because of the number of variables in material, packaging, environment and applications that can affect their selection. For example, depending on what kinds of assets you want to track, the reflective nature of any metals they or their packaging may contain (or the absorptive nature of their liquid contents) can pose challenges that can define what kinds of tags you need.

Then, depending on your specific requirements, different kinds of tags are available with different prices. Active, battery-powered ones cost more than passive, inductive ones, but the former can be read from a much longer range. Read/write tags cost more than read-only tags, but they can have information added to them in their transit affixed to pallets, cartons or items.

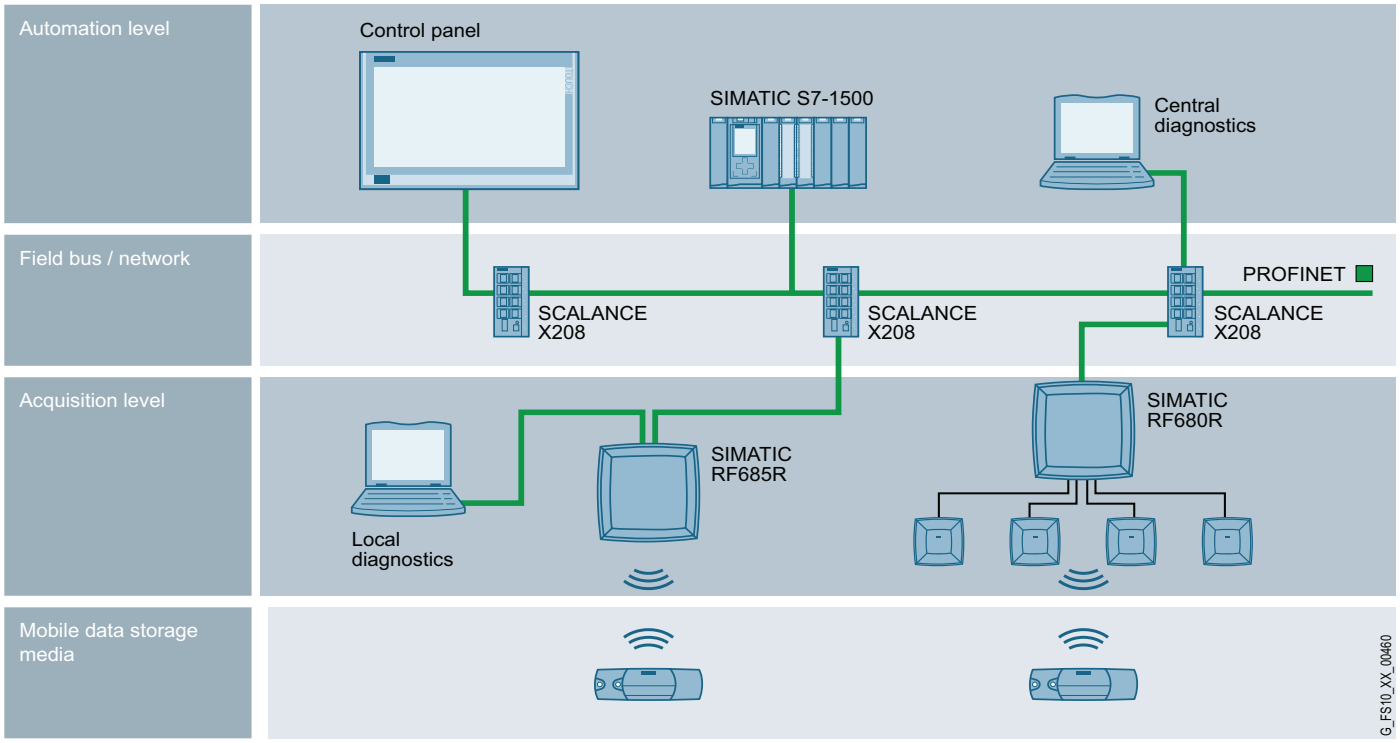
Economics in most cases will guide the choice of the type of tag used, if not whether RFID is deployed at pallet, case or item levels. High-cost tags (e.g., 50 cents or more) don't make sense for low-cost items. On the other hand, they may prove economical for cases of goods, high-cost items or items that are prone to shrinkage.

Placement is a related issue – just having the right tag for your application isn't enough. The tag typically needs a consistent placement on every pallet, carton or item in order to be correctly read in the many and varied scenarios it can travel through on its way to its final destination.

RFID Readers
RFID readers can feature various levels of intelligence from dumb (and cheap) serial devices to smart (and more expensive) web-enabled appliances. Each can have a host of maintenance and management requirements.

Among those are firmware that has to be upgraded periodically; status that needs polling by the minute, hour or day; queues to be dumped and processors to be reset; and maintenance schedules to be maintained. These tasks might not be burdensome if the number of devices is few. But some deployments might require hundreds, if not thousands, of readers along with a commensurate scale of upkeep.

Further, in open intercompany RFID applications, managing devices can become even more complex as the workload needs to be shared in some consistent and dependable way across different members of the supply chain. Needed will be a meta-network to manage the devices, performing the maintenance, diagnostics, resets and so on. To save on costly technician service calls, these activities can be done remotely via electronic interaction as much as possible.



Data Management
Once your RFID system starts generating asset-tracking data, what do you plan do with it? This is where your IT professionals are especially needed. Business analysts can also help formulate a set of business rules to govern how RFID data must be used and who must interpret and respond to it. They should also identify procedures for passing data to higher management.

First, however, they will have to determine the kinds of data that will come from your system. Then consider where it will go, specifically its receiving systems and databases. Think about the data records within each system and database that it will populate. Even small details like field character length in a database record might need changing if the data string is too long for it.

Hosted and cloud-based data platforms, public or private, can provide ready-to-use, pay-as-you-go options, if in-house resources are unavailable for incremental use by your RFID system. One big advantage of the hosted and cloud-based data management is scalability, availability and reliability.

5. Installation, tuning and testing

Once the feasibility test, pilot or launch has been planned, systems must be installed in a broad array of facility scenarios from dock doors, walkways, conveyors, trolleys, totes and-wheeled carts, forklifts, pallet bays, storage areas and other placements.

For each scenario, antennas must be mounted to both exploit the reflective characteristics of the scenario and to achieve the RFID objectives at the site and scenario location. Each antenna position must be calibrated for maximum real performance, using tagged items, cartons or pallets to verify the tuning depending on the level of RFID required. Theoretical performance adjustments are not acceptable.

Reader Synchronization.
Especially challenging scenarios are those that require multiple RFID systems synchronized to work in harmony without interfering with one another or with neighboring systems. This can be done by time-based synchronization of a reader group to a common clock and careful placement of antennas. RFID systems must be synchronized to transmit at different times. A failure to properly synchronize readers that have antennas close enough to transmit to each other can result in reduced system performance. That's because the tags themselves get confused by multiple simultaneous requests for transmission of their EPCs.

Finally, testing before go-live is critical, especially to flush out RF interference issues. Given the different elements and levels of an RFID system's operation – tags, readers and communications on the operational floor, then data integration with back-office databases and other systems – you should expect glitches. At the same time, you should

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test how well users interact with the system, to the extent interaction is required. Ergonomics and human factors need to be taken into account to ensure your system's usability.

6. Communications and training

This last step is as important as all the others. As part of your RFID project plan, you should identify all functional stakeholders in its success. Note by name the individuals who represent those functions, especially those who will be using or supporting the system. As the project progresses, you should keep them informed of key milestones and timetables, to avoid surprises.

It's especially important to communicate with the workers whose jobs will be impacted in some way, for better or worse. Even if the RFID system is going to make their jobs much easier, they might fear their jobs are threatened without proper communications and understanding. As a result, they could conspire (consciously or not) to sabotage and defeat the system.

Finally, before the system's go-live date, be sure to fully train users in how to use the system and basic troubleshooting. If they don't understand how the hardware and software works, they won't be able to help deal with potential problems or improvement opportunities as needed.

Conclusion

This paper covers a lot of ground in describing how to successfully implement an RFID asset-tracking system – and whole books have been written about this subject. At this point, however, some readers might think that deploying an RFID application may be too costly, complex or disruptive for their company's operations and resources. We want to assure them that it doesn't have to be.

Well-conceived business cases for RFID asset-tracking systems based on conservative assumptions can often produce paybacks in 18-24 months. Like any industrial application, RFID requires careful planning, engineering and execution with expert and experienced assistance.

If you don't have the RFID expertise and experience in-house, we advise that it's vital to your project's success to find qualified outside help. The additional investment will typically more than pay for itself in a faster deployment with fewer project and operational risks. You'll also be much more likely to realize your return on investment (ROI) much sooner. And, once you've achieved your initial payback, your ROI will only grow larger and larger over time.

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Order No: FSWP-RFIDT-1014

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