ISSN: 2583-9888
DOI: doi.org/10.51219/JAIMLD/anand-kumar/64

URF PUBLISHERS
connect with research world

Journal of Artificial Intelligence, Machine Learning and Data Science

https://urfpublishers.com/journal/artificial-intelligence

Vol: 1 & Iss: 1

Research Article

Embedding RFID in SAP EWM - Inventory Traceability and Streamlining Warehouse Operations

Anand Kumar Percherla*

SAP Business Analyst, Richemont North America Inc., Dallas, USA

Citation: Anand Kumar. Embedding RFID in SAP EWM - Inventory Traceability and Streamlining Warehouse Operations. *J Artif Intell Mach Learn & Data Sci 2022*, 1(1), 173-181. DOI: doi.org/10.51219/JAIMLD/anand-kumar/64

Received: March 08, 20222; **Accepted:** March 28, 2022; **Published:** March 30, 2022

***Corresponding author:** Anand Kumar PERCHERLA, SAP Business Analyst, Richemont North America Inc., Dallas, USA, E-mail: anand.percherla@richemont.com

ABSTRACT

As a leader in warehouse management or a seasoned supply chain expert, you undoubtedly grapple with the intricate complexities and obstacles inherent in inefficient warehouse operations. Your spectrum of responsibilities spans meticulous inventory tracking to optimizing storage and picking procedures, demanding your unwavering focus. Fortunately, amidst these challenges, a ray of hope emerges in the form of Radio-Frequency Identification (RFID) technology. This technology presents a transformative solution to streamline and elevate warehouse operations to unprecedented levels. When seamlessly integrated with SAP Extended Warehouse Management (EWM), RFID becomes a catalyst that revolutionizes your warehouse management approach, paving the way for an era of unparalleled efficiency and productivity.

This article offers a comprehensive overview of the integration of RFID technology with S/4HANA EWM (Extended Warehouse Management). The exploration will delve into typical requirements and business benefits, examine the architecture of RFID, discuss its standard support and processes, and shed light on some of the equipment involved in this integration.

Keywords: RFID, SAP, EWM, Warehouse Management.

1. Introduction

While RFID technology isn't a recent innovation, its recognition has only recently reached a point where it is poised to become a commonplace concept. Like computer networking technologies developed in the late 60s and 70s, which are now pervasive due to widespread internet adoption, RFID technology is on track to become ubiquitous with the rise of the "Internet of Things" (coined at M.I.T. to describe a network of RFID-enabled objects). This article serves as an introduction, aiming to provide those interested in learning about the technology with a basic understanding of some key points about RFID.

Much like the Internet, which originated as a DARPA research project, RFID technology is believed to have evolved in the pursuit of enhancing warfare technologies. In World War II, the British introduced IFF (Identification Friend or Foe), using radar signals to determine the allegiance of a given fighter plane, preventing friendly fire and enabling a quicker response to approaching enemy aircraft. While airplane identification was an initial use of the technology, it is now employed to identify a diverse range of items, including consumer goods and construction machinery[1].

The utilization of RFID dates to World War II when it was initially employed as a form of radar to locate Allied planes. Below is a concise history outlining the evolution of RFID technology:

1940: The concept of RFID is introduced for the first time to identify and authenticate aircraft in flight, known as IFF (Identify Friendly Foe). This application aims to facilitate the identification of allied planes.

1970: From 1960-1970, RFID systems are maintained as confidential military technology, primarily for controlling access to sensitive sites, including nuclear facilities. However, some companies also started to use this technology during this period.

1980: Technological advancements lead to the development of the passive tag. The retro RFID tag modulates the wave radiated by the interrogator to transmit information. This innovation eliminates the need for an embedded energy source on the label, thereby reducing cost and maintenance.

1990: RFID technology begins to undergo standardization, enabling its compatibility with other systems.

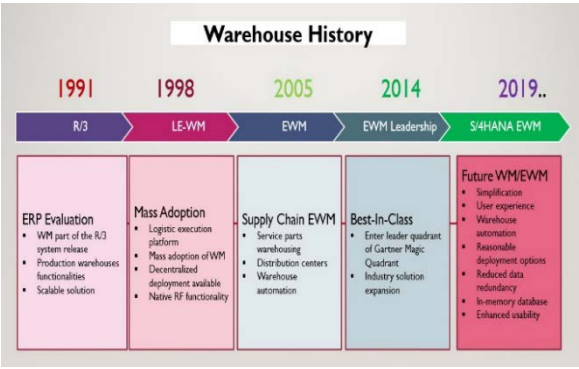
1999: The Massachusetts Institute of Technology (MIT) establishes the Auto-ID center, a research center specializing in automatic identification.

2003: The MIT center evolves into EPCGlobal, an organization advocating for the Electronic Product Code (EPC), extending the use of RFID beyond barcodes.

Starting 2005: RFID technologies become widely adopted across various industrial sectors, including aeronautics, automotive, logistics, transportation, health, and daily life. The International Standard Organization (ISO) plays a significant role in implementing technical and applied standards to achieve interoperability.

2009: The National RFID Reference Center is established[2].

SAP Extended Warehouse Management (EWM) serves as a robust solution for the effective management of warehouse inventory and facilitates the streamlined processing of goods movement. This system empowers companies to exert control over both inbound and outbound warehouse processes, ensuring the seamless flow of goods within the warehouse. SAP EWM plays a pivotal role in orchestrating all goods movements through a warehouse management system, providing comprehensive tools for monitoring warehouse activities. Beyond basic inventory control, SAP EWM encompasses a range of additional warehouse functions, including the creation of serial numbers, batch numbers, vendor management inventory, resource optimization, and value-added services. This system not only monitors the quantity of goods within the warehouse but also efficiently manages critical functions, ultimately enhancing the delivery of goods[3]. The image below illustrates the evolution of Warehouse Management in SAP since the R/3 era.



Since its introduction by SAP in 2005, Extended Warehouse Management has offered various deployment options. Initially decentralized and based on SCM Business Suite, SAP now allows users to deploy EWM either embedded within the S/4HANA enterprise management solution or in a decentralized manner on a separate instance connected to S/4HANA or SAP ECC. Decentralized EWM offers integration with multiple SAP ERP systems at single or multiple locations, providing flexibility for independent upgrades and the addition of functionality outside SAP's predetermined roadmap. For warehouses operating around the clock, 365 days a year, with high-volume operations reaching hundreds of thousands of units per day, decentralized EWM emerges as the preferred choice. Its ability to sustain warehouse operations even during ERP system downtime contributes to its appeal for such demanding environments.

RFID technology proves valuable in tracking the movement of hazardous materials, ensuring their proper storage and handling. Additionally, it plays a crucial role in monitoring access to restricted areas, thereby mitigating the risk of unauthorized access or theft.

SAP Extended Warehouse Management (EWM) stands as a module within the SAP supply chain management system, providing advanced warehouse management capabilities. Through the integration of RFID with EWM, warehouses gain access to real-time tracking and data collection features, enabling them to optimize their operations efficiently.

2. Literature

RFID (radio frequency identification) is a wireless communication method utilizing electromagnetic fields (radio waves) to locate and identify tags affixed to objects. These tags store electronic information that can be wirelessly read by an RFID reader. In contrast to barcode scanning, RFID doesn't require a direct "line-of-sight" for detection and identification. It excels at swiftly identifying numerous items, processing tens, hundreds, or more items per second.

Like various other automatic identification systems, an RFID system comprises several interconnected components. Broadly speaking, an RFID system must include a collection of tags, one or more antennas, and a reader.

Basic RFID system components.

Tags serve as devices affixed to the items or materials tracked by the RFID system[4].

They can be directly placed on individual items, as seen with consumer goods, or on larger entities like shipping containers or pallets containing multiple items. Tags come in various shapes and sizes. The primary role of a tag is to transmit data to the rest of the RFID system, typically consisting of three fundamental parts:

The electronic integrated circuit

A miniature antenna

A substrate holding the integrated circuit and antenna together, attached to the inventory item.

Tags are classified based on their power source, leading to distinctions such as:

Passive.

Active.

Semi-Passive.

RFID Technology Comparison

	Passive	Active	Semi-Passive
Power source	External Electromagnetic antenna field	On-board battery	On-board battery for internal circuitry External electromagnetic field for transmission
Range	Measured in feet	Up to thousands of feet	Measured in feet
Size	Smaller	Larger	Larger
Data storage	Less	More	More
Cost	Less	More	More

Refer to the figure below for a comparison of different tag types[4].

Scanners and Readers play a crucial role in RFID systems. The RFID reader is a device that generates an electromagnetic signal transmitted to RFID tags through one or more antennas. In typical operation, the reader continuously sends out the electromagnetic signal, actively searching for one or more RFID tags. Additionally, the RFID reader serves a second function by monitoring electromagnetic signals emitted by RFID tags, all accomplished through the same antenna.

Antennas play a crucial role in RFID systems as they are responsible for both transmitting and receiving electromagnetic signals between the tags and the reader. The electromagnetic field effectively transmitted by the antenna is referred to as the interrogation zone in RFID terminology. Essentially, the antenna establishes a three-dimensional space used for communication with RFID tags. For successful communication, the tags need to be within the range of the antenna or within the defined interrogation zone.

The **Host** in an RFID system refers to a computer system responsible for communicating with the RFID reader. It is the host that interprets the input received from the reader. Typically, the host system is equipped with multiple software applications to support the RFID system. One commonly used application is RFID middleware, enabling users to configure and control the reader. Another essential software application involves data management, encompassing functions related to database management and inventory tracking[4].

RFID standards play a crucial role in providing guidelines and specifications for the development and use of RFID technology. These standards offer insights into how RFID systems function, the frequencies they operate on, the data transfer process, and the communication between the reader and the tag.

Industry-specific, national, regional, and global bodies are responsible for developing and issuing these standards. Notable organizations such as the International Standards Organization (ISO) and GS1 collaborate to approve standards and protocols, establishing universal specifications for RFID equipment. The creation of global standards by these organizations facilitates the potential for worldwide adoption of RAIN RFID.

3. Some of the Current and Emerging RFID Standards

The **International Organization for Standardization (ISO)** is a global entity dedicated to developing and releasing standards across various sectors, including RFID. ISO standards offer universal specifications and guidelines for RFID components, covering areas like tag data formats, air interface protocols, security features, and performance testing. Among the notable ISO standards for RFID, ISO 14443 addresses contactless smart cards, ISO 15693 focuses on vicinity cards, ISO 18000 pertains to air interface communication, and ISO 19794 deals with biometric identification. These standards play a vital role in ensuring compatibility and interoperability within the RFID ecosystem.

The **Electronic Product Code (EPC)** system is designed to assign unique identifiers to RFID tags, and these identifiers can be stored and accessed within a networked database known as the EPCglobal Network. Initially developed by the Auto-ID Center, a collaborative effort involving academic and industry partners, the EPC system is currently managed by GS1, a non-profit organization overseeing global supply chain standards. EPC standards play a pivotal role in defining the structure and format of EPC codes. Additionally, they specify protocols and interfaces for the EPCglobal Network, including EPC Gen2 for UHF tags, EPCIS for data exchange, and EPC Discovery for tag discovery[5]. These standards contribute to the seamless functioning and interoperability of the EPC system within the global supply chain.

3. RFID in SAP EWM

Leveraging Extended Warehouse Management (EWM) in conjunction with SAP Auto-ID Infrastructure (SAP AII) allows for the optimization of warehouse processes through the implementation of RFID technology. RFID integration in EWM facilitates contact-free identification, control, and tracking of packaged products and handling units. This is achieved by utilizing RFID labels equipped with integrated RFID tags. The seamless integration of RFID in SAP EWM enhances efficiency and accuracy in warehouse management, providing a robust solution for streamlined operations.

3.1 RFID in EWM offers following options

Creating and printing RFID labels for handling units and packaged products, Triggering automatic pre-defined and custom actions etc.,

Writing and Printing RFID Labels: Generate RFID labels containing essential information for handling units and packaged products. Utilize RFID technology to encode data onto these labels. Print the labels with integrated RFID tags.

Scanning RFID Labels and Reading Data: Use RFID scanners to read the data embedded in the labels, such as Electronic Product Codes (EPCs). Extract relevant information from the scanned RFID labels.

Automatic Triggering of Standard Actions: Implement automatic actions triggered by the scanning activity, including:

Confirming warehouse tasks.

Automatically loading and unloading items.

Initiating automatic packing processes.

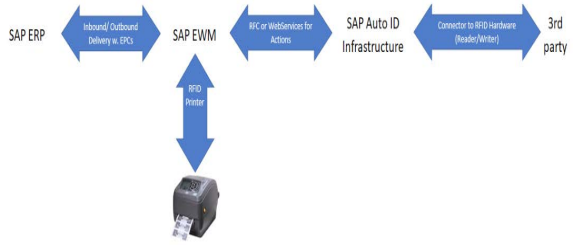
Automatic Trigger of Custom Actions: Enable the automatic triggering of custom actions tailored to specific

business needs. Define and implement custom actions based on the data obtained from scanned RFID labels.

This integrated process enhances operational efficiency by automating key warehouse tasks and allowing for customized actions based on RFID scanning activities[6].

4.2 Basic architecture of RFID with SAP EWM:

The architecture outlined below is a simple representation of the integration with SAP EWM. Interaction is facilitated through web services or RFC (Remote Function Call) modules for seamless communication with SAP EWM.



SAP EWM and RFID – Architecture outline

Indeed, RFID support for Electronic Product Code (EPC) has been available in SAP EWM since version 5.1. To leverage this functionality, SAP EWM needs to be integrated with SAP AII (Auto ID Infrastructure). SAP AII is a distinct software component operating on the Netweaver stack, and it establishes connectivity with SAP EWM through RFC (Remote Function Call) or web services[7].

In the standard **SAP environment**, the predominant method for incorporating RFID functionality is using SAP Auto-ID Infrastructure (SAP AII). This is a separate system from SAP S/4HANA, designed to provide specific capabilities for interfacing with RFID equipment such as RFID scanners and printers. SAP AII not only facilitates the connection with RFID-specific devices but also supports the creation of RFID identifiers and the decoding of information stored in RFID tags. This segregation of systems allows for a specialized approach to RFID integration within the broader SAP ecosystem.

4.2.1 SAP Auto-ID Infrastructure (SAP AII) functions as a middleware system designed to receive data from RFID data capture sources, typically RFID readers. It seamlessly integrates the data obtained from RFID tags directly into the enterprise application. SAP Auto-ID comprises two main components:

a. Core Services: This component encompasses a flexible environment for defining rules and parameters. It provides a ruleset environment that allows for adaptable configurations.

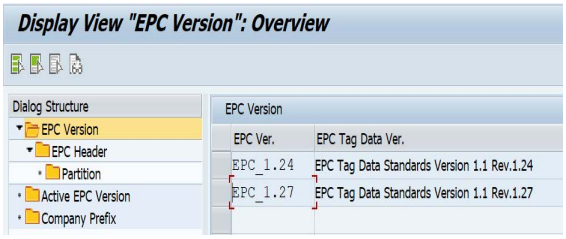
b. Integration Services: Auto-ID interacts with three distinct environments:

Backend systems via SAP XI (Exchange Infrastructure).

RFID devices, serving as the communication link between Auto-ID and RFID-specific equipment.

Web user interface for control and user maintenance.

The identification (ID) within SAP Auto-ID is represented using various ID types, with an example being the EPC code - EPC_1.27 (EPC Tag Data Standards Version 1.1 Rev.1.27). This illustrates the compatibility and adherence to standardized RFID data formats within the Auto-ID Infrastructure.



The **Electronic Product Code (EPC)** stands as a widely adopted identification method in the realm of RFID, providing a schema to uniquely identify physical objects through RFID tags. The fundamental structure of the EPC coding on an RFID tag consists of a bit string, represented in binary, featuring a header followed by a sequence of numeric fields. The length, structure, and position of these fields are determined by the header value. Users have the flexibility to define their own IDs in binary or natural language and create custom coding and decoding schemas for them.

EPCs are easily utilized on RFID tags, and when retrieved, the EPC data can be linked with dynamic information like the place of origin or date of manufacture. The ID type defines the structure, length, and position of components within an ID. The coding type, on the other hand, specifies the construction schema within an ID type. For the ID type EPC_1.27, examples of coding types include **SGTIN-96 and SSCC-96**.

While data on the tag is encoded in a binary format, it is written in **URI (Uniform Resource Identifier)** notation outside of the tags and within SAP EWM.

There are two ways to write the EPC:

Pure Identity URI:

Used for EPCIS (EPC Information Services) purposes and stored in SAP EWM.

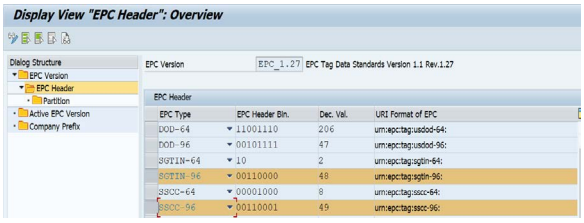
Example encoding for SSCC:

urn:epc:id:sscc:12345678.100000174

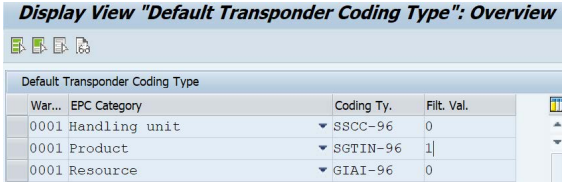
EPC Tag URI:

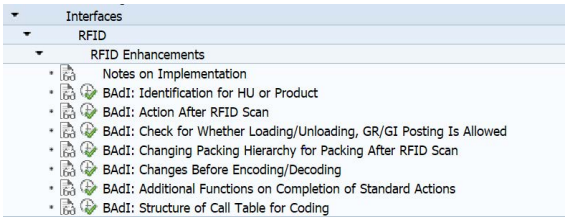
Used in RFID communication but not stored in the tag. Contains additional information.

Example encoding for SSCC-96: **urn:epc:tag:sscc-96:2.12345678.100000174**



There are also corresponding standard implementations for these coding types in EWM and BADIs available for RFID enhancements. See below picture, Spro Img Path in EWM





The RFID data flow described provides insight into how information is captured and processed within the SAP Auto-ID system and its integration with SAP ERP through SAP XI (Exchange Infrastructure). Here is a summary of the process:

RFID Reader Activation: RFID reader activates a tag, capturing information from the RFID tag.

Device Controller: Captured information is sent to the device controller.

Communication to SAP Auto-ID: Information is transmitted to the SAP Auto-ID system using either Extensible Markup Language (XML) or Product Markup Language (PML).

SAP Auto-ID Core Services: Core services in SAP Auto-ID verify the captured data against defined rule definitions.

Communication to SAP XI: Verified data is sent to SAP XI via XML.

XML to IDOC Conversion: SAP XI converts the XML data into an Intermediate Document (IDOC).

Transmission to SAP ERP: The IDOC is transmitted to SAP ERP.

Mapping Process: SAP XI undertakes a mapping process to translate the data from XML to the format required in the IDOC.

SAP ERP Data Verification and Processing: SAP ERP receives the IDOC, verifies the data, and processes it based on predefined rules in SAP Auto-ID.

4.2.2 Automated goods receipt

For example, if the captured data is related to a goods receipt, SAP ERP automatically generates a goods receipt based on the rules defined in SAP Auto-ID.

This end-to-end process ensures seamless integration between RFID data captured in the field, SAP Auto-ID system verification, and automated processing in SAP ERP.

The mapping process in SAP XI plays a crucial role in translating data formats for smooth communication between the systems.

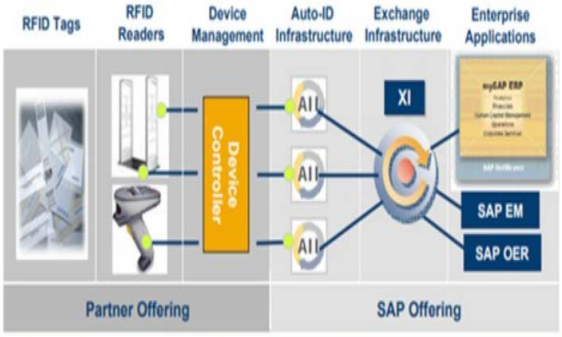


Image Source[8]

4.2.3 SAP Auto-ID provides users with two distinct user interfaces to cater to different needs:

Mobile User Interface:

Designed for use on handheld devices (PDAs) for on-the-go access. Allows users to interact with SAP Auto-ID functionalities while mobile[8].

Desktop User Interface:

Used for entering SAP AII settings. Provides a comprehensive interface for users to manage SAP AII configurations and settings on a desktop.The standard SAP AII system comes equipped with a predefined set of rules and associated activities. Users have the flexibility to customize these rules or introduce new ones through the user interface[8].

In the context of warehouse management, SAP Extended Warehouse Management (EWM) offers a comprehensive solution that can address the highest requirements of warehouse automation. It provides an end-to-end solution, effectively mapping and addressing the functional scope while managing and controlling complexity in warehouse processes. This integration ensures seamless and efficient operation, from RFID data capture to warehouse automation and control through SAP EWM.

4.3 Configuration settings for RFID in SP EWM

When integrating the middleware system SAP Auto-ID Infrastructure (SAP AII) with SAP Enterprise Application and SAP Extended Warehouse Management (EWM) systems, certain prerequisite customizations need to be configured in the EWM system. These configurations are specific to tasks such as printing RFID labels or automating business process flows.

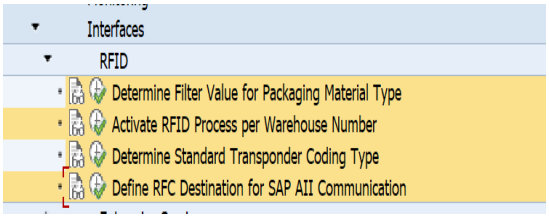
To enable the complete range of RFID functions in SAP Extended Warehouse Management (EWM), you need to make specific Customizing settings in the SPRO IMG (Implementation Guide). Here are the steps for the mentioned settings:

a. Define Filter values for packaging material types.

b. Activate RFID Process per Warehouse Number

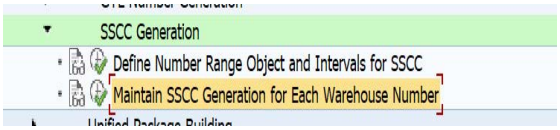
c. Determine Standard Transponder Coding Type

d. Define RFC Destination for SAP AII Communication



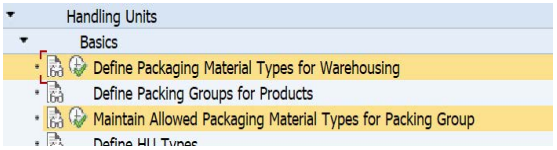
e. Define Number Range Object and Intervals for SSCC

f. Maintain SSCC Generation for Each Warehouse Number

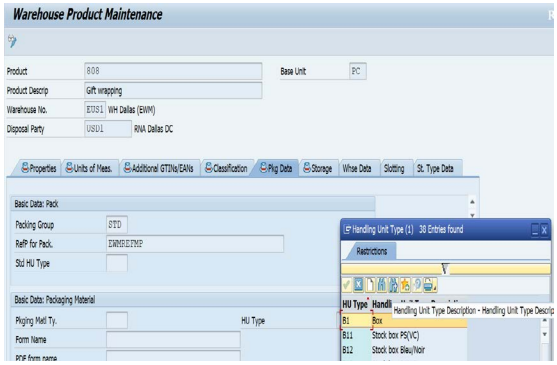


g. Define Packaging Material Types for Warehousing

h. Maintain Allowed Packaging Material Types for Packing Group



Check HU type in EWM product master data - /SCWM/MAT1 that has a matching a package material type with ERP packaging materials and set the HU type.

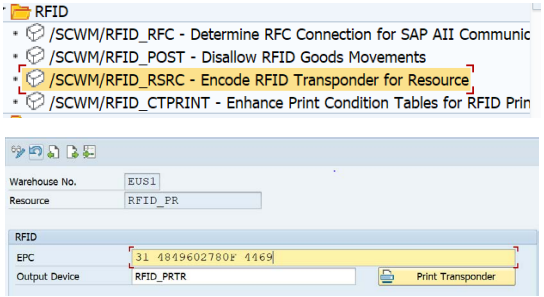


To assign an EWM RFID resource to an EPC code and associate it with an RFID device and printer, you can follow the steps outlined in the Easy Access menu or use the transaction code /SCWM/RFID_RSRC. Additionally, after assigning RFID tags to resources, you can activate the BAdI (Business Add-In) - Write Transponder for Resource.

Here's a **general guide**:

4.3.1 Assign RFID resource to EPC code

Enter /SCWM/RFID_RSRC in the command field and press Enter. In the assigned transaction, you can assign an EWM RFID resource to an EPC code. Specify the RFID device and printer associated with the resource. Save your entries. See below.



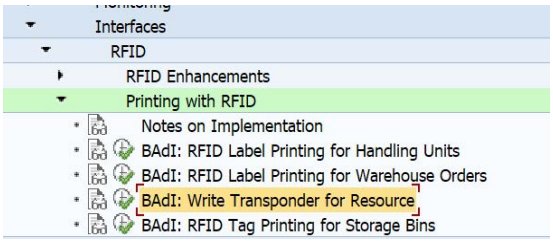
4.3.2 Activate BAdI - write transponder for resource

Enter /SCWM/RFID_BADI in the command field and press Enter. In the transaction, activate the BAdI - Write Transponder for Resource. This BAdI allows you to implement custom logic for writing transponder data associated with resources.

4.3.3 Custom logic implementation

Implement your custom logic in the BAdI to handle the writing of transponder data for the assigned resources. Save your changes and activate the BAdI.

Please note that the specific details and options in these transactions may vary based on the version of SAP EWM you are using. Refer to your system documentation or consult with SAP experts for detailed and version-specific instructions.



To enable the printing of RFID labels in SAP EWM, you need to add condition records for printing Handling Units and warehouse orders. This can be done using the transactions / SCWM/PRHU6 and /SCWM/PRWO6.

Additionally, you may need to activate printing BADIs (Business Add-Ins) to implement custom logic for printing. Here are the general steps:

Adding Condition Records:

Enter /SCWM/PRHU6 in the command field and press Enter. Maintain condition records for printing Handling Units.

Enter /SCWM/PRWO6 in the command field and press Enter. Maintain condition records for printing warehouse orders.

Activating Printing BADIs:

Enter /SCWM/RFID_BADI in the command field and press Enter. Activate the Printing BAdI:

In the transaction, activate the relevant BAdI for printing RFID labels. Depending on your requirements, you may need to activate multiple BADIs related to printing.

Custom Logic Implementation:

Implement custom logic within the activated BAdI to handle printing processes. This may involve integrating with external printing systems, specifying label formats, or other printing-related requirements. Save your changes and activate the BAdI.

By following these steps, you can configure condition records for printing Handling Units and warehouse orders and activate the necessary BADIs to implement custom logic for RFID label printing in SAP EWM.

4.4 The Goods Receipt (GR) process in SAP Extended Warehouse Management (EWM) involving RFID unfolds as follows:

1. Inbound Delivery from SAP ERP:

SAP ERP initiates the process by sending an inbound delivery to SAP EWM. The inbound delivery includes EPC (Electronic Product Code) information at the handling unit level.

2. Unloading of Handling Units:

Handling units with RFID labels are unloaded through a simple or complex process. SAP Auto-ID Infrastructure (SAP AII) identifies the goods movement and scans the RFID tag on the handling unit.

3. Information Transmission to EWM:

SAP AII transmits the RFID tag information to the SAP EWM system. In response, the EWM system sets the status of the scanned handling unit to "Unloaded."

4. Automatic Goods Receipt Posting:

The EWM system automatically performs a goods receipt posting based on the RFID information. This includes updating inventory levels, updating documents, and other relevant processes.

5. Inbound Delivery Update to ERP:

The EWM system sends the updated inbound delivery, including EPC information and goods receipt posting details, back to the SAP ERP system.

6. Put Away Process:

If the destination storage bin for the handling unit has a stationary RFID device, the warehouse task of the handling unit is confirmed during the put away process. The HU identification, decoded by the EPC code, is sent to EWM. The warehouse task is confirmed in the background, indicating that the handling unit has been successfully placed in its destination storage bin.

This process showcases the integration of RFID technology with SAP EWM to streamline and automate the goods receipt and put away processes. It promotes real-time visibility and accuracy in inventory management[6].

4.5 The Goods Issue (GI) process in SAP Extended Warehouse Management (EWM) with RFID involves the following steps:

1. Picking Using RFIDs:

Products or handling units (HUs) are picked using RFID technology. RFID devices are used to identify and capture information about the picked items.

2. Packing, Repacking, and Labeling:

After physical packing, repacking, or labeling, new handling units (HUs) are created in SAP EWM. Workers use RFID devices to update EWM with the new HU hierarchy. The worker places the HU on a conveyor belt with a stationary RFID device for further processing.

3. Internal HU Movements:

Automatic Confirmation of Warehouse Task:

Warehouse tasks associated with internal HU movements are automatically confirmed. If desired, the username of the worker can be entered for traceability. For example, a worker raises an HU with a forklift, and the forklift (or user) is identified by its own RFID tag.

RFID Confirmation at RFID Door:

As the HU and resource (forklift/user) move through an RFID door, EWM confirms the open warehouse task by scanning the RFID tags.

The RFID tag on the resource provides the name of the user logged onto the resource for task confirmation.

4. Loading Using Manual Goods Issue Posting:

The loading process involves manually posting goods issue by scanning RFID labels on the handling units. The system identifies the HUs through RFID tags, making the loading process efficient and accurate.

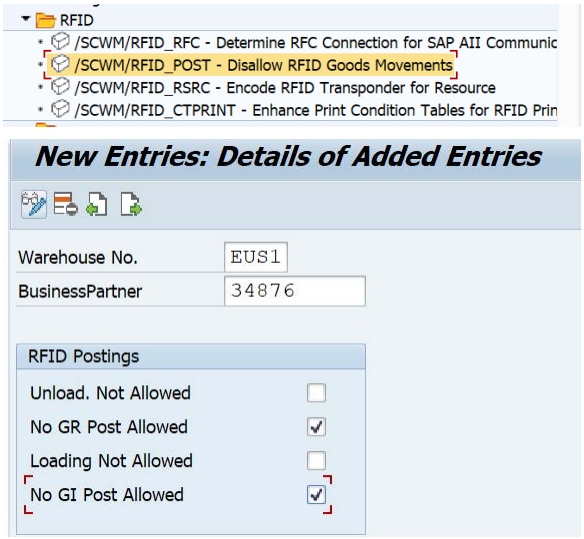
5. Advanced Shipping Notification (ASN):

After goods issue posting, the system sends an advanced shipping notification (ASN) to SAP ERP.

The ASN includes the required Electronic Product Code (EPC) data for traceability and information exchange.

This process demonstrates the integration of RFID technology in the goods issue process, providing real-time visibility, traceability, and automation for improved warehouse operations[6].

In SAP Extended Warehouse Management (EWM), you can configure the restriction of RFID functionality for goods movements at the partner level. This can be set up at the Easy Access Menu level. See below



4.6 Technical Details of SAP EWM RFID

When working with RFID in SAP Extended Warehouse Management (EWM), there are several key objects and components to be aware of. Let's break down the technical details:

1. Function Groups

Function Group: **/SCWM/RFID**

Function Module: **/SCWM/RFID_ACTION**

This function module is RFC (Remote Function Call) enabled and is called AII (Auto-ID Infrastructure). It serves as the central component for performing various RFID actions in EWM[7]. Actions that can be performed using /SCWM/RFID_ACTION:

Unload: Unloads Electronic Product Codes (EPCs) through RFID from an inbound delivery.

Requires pre-existing EPCs stored in the inbound delivery.

Move: Moves handling units (HU) or other entities within EWM. Requires an open warehouse task (WT) for the specified HU in the standard configuration.

Pack: Packs Global Trade Item Numbers (GTINs) into an HU EPC or packs HUs into another HU. Hierarchy must be clear through scanning, or it can be defined in a BAdI (/SCWM/EX_RFID_PACK_ACTION).

Load: Loads an EPC in the outbound loading process.

2. Classes

Class: **/SCWM/CL_RFID**

Contains core methods for creating, modifying, and deleting EPCs in EWM. Manages the persistence layer.

Class: **/SCWM/CL_RFID_ACTION**

Called from the action function module (/SCWM/RFID_ACTION). Provides insights into the structure of the RFID actions.

Class: **/SCWM/CL_RFID_SERVICES** - Includes additional services related to RFID[7].

3. Persistence Layer

Tables: Table: **/SCWM/EPC** - Holds all EPC data, including products (GTINs), handling units (HUs), and resources with RFID assignments.

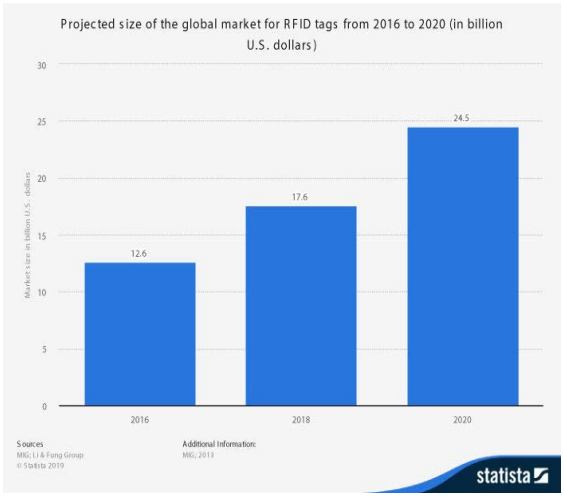
Table: **/SCWM/EPC_ASSN** - Contains EPCs assigned to other EPCs, such as a packed GTIN in an HU or a nested HU.

These tables store and manage the RFID data, ensuring the persistence and traceability of EPC-related information in the SAP EWM system. Understanding these function groups, classes, and tables provides a foundation for working with RFID functionality in SAP EWM, enabling the integration of RFID technology into various warehouse processes[7].

7. Real world use cases in Supply chain with RFID

RFID (Radio Frequency Identification) technology is renowned for its applications beyond asset tracking and inventory management. While it excels in these areas, RFID's versatility extends to various industries, with the retail sector being particularly prominent. In retail, RFID is widely employed for tasks such as product tracking, inventory visibility, supply chain optimization, and enhancing the overall customer shopping experience. Its ability to provide real-time data and streamline processes makes RFID a valuable tool in improving operational efficiency and ensuring accurate and timely information in retail settings.

The growth of RFID technology, as indicated by the projected market size of around 24.5 billion U.S. dollars in 2020 according to Statista, is indeed remarkable. The fact that retail applications are anticipated to hold the largest share of this market highlights the effectiveness and widespread adoption of RFID. The doubling of RFID's global market in just four years underscores its efficiency and the diverse range of applications that contribute to its success across various industries. This growth trend further emphasizes the increasing recognition of RFID as a valuable and effective technology in addressing diverse needs, particularly in sectors such as retail.



7.1 Five Companies that utilize RFID technology:

1. Amazon's Research and Development teams are actively engaged in advancing RFID technology to enhance the customer experience significantly. One notable innovation from the Amazon Go team exemplifies this commitment. With the RFID Amazon app, customers entering an Amazon store can seamlessly make purchases without the need for registration or traditional checkouts[9].

In essence, the Amazon Go experience is encapsulated in the tagline "Just Walk Out." This revolutionary approach allows customers to enter the store, select their desired products, and simply walk out, eliminating the need to wait in queues or invest time in traditional checkout processes. The integration of RFID technology in this context streamlines the shopping experience, offering unparalleled convenience and efficiency for customers at Amazon Go stores.

2. Zara, a prominent fast-fashion retailer, has leveraged RFID technology for inventory tracking, addressing challenges such as counterfeit products, which is a significant issue in the clothing industry. RFID proves to be a valuable tool in overcoming these challenges by providing precise information about all clothes[9].

One notable advantage of RFID in this context is the ability to gain real-time insights into the availability of clothing items. By tagging each garment, Zara can accurately track stock levels and receive notifications when an item is sold. This proactive approach enables efficient restocking of fast-selling items, ensuring that popular products remain available for customers. This technology has been successfully implemented across hundreds of Zara stores, contributing to improved inventory management and a more seamless shopping experience for customers.

3. H&M, a longstanding rival of Zara, initially experienced rapid growth but later faced a decline in product sales, allowing other brands like Zara and Asos to gain a competitive advantage. In response, H&M's top management underwent a strategic shift, placing a significant focus on technology, particularly in areas such as distribution center automation, meta-information analysis, and RFID garment labeling[9].

This shift in strategy aims to empower staff members to proactively address issues related to stock levels, whether it's undersupply or oversupply. The implementation of RFID technology plays a crucial role in this initiative, helping level the playing field among retail top brands. By concentrating on distribution efficiency and leveraging RFID for garment labeling, H&M aims to enhance its operational agility.

The utilization of RFID not only provides valuable data but also aids in equalizing competition among top retail brands. H&M's commitment to improvement and customer attraction strategies, coupled with RFID technology, is expected to contribute to increased sales and earnings. The data obtained through RFID can play a pivotal role in refining sales strategies and enhancing customer engagement.

4. Decathlon, a prominent global retailer specializing in sportswear, shoes, and other merchandise, operates on a massive scale, selling over 600 million individual items annually across the world through thousands of stores in Europe, Africa, South America, and Asia. One of Decathlon's primary objectives is to ensure that products are readily available in stores for customers willing to make a purchase, aiming to avoid any customer disappointment and potential loss of sales[9].

To achieve this goal and enhance the overall customer experience, Decathlon opted for the strategic implementation of RFID technology. The use of RFID not only ensures that products are in stock and accessible for customers but also facilitates a quick and efficient checkout process. The integration of RFID solutions into its supply chain allows Decathlon to stay true to its commitment of never disappointing customers by maintaining optimal inventory levels and streamlining the shopping experience. This strategic decision reflects Decathlon's dedication to leveraging technology to meet customer expectations and drive customer satisfaction.

5) **BJC HealthCare**, a major nonprofit healthcare organization operating several hospitals in Illinois and Missouri, has been at the forefront of utilizing radio frequency identification (RFID) technology to enhance various aspects of healthcare management. This organization, one of the largest nonprofit healthcare entities in the United States, has implemented RFID for several years across different areas of its operations.

In the realm of surgery tools and medicinal stock supplies, BJC HealthCare employs RFID technology to track and manage a vast quantity of items. This includes monitoring the validity dates of medical supplies, ensuring timely replacements when needed. Additionally, RFID is utilized on patients to keep track of their health records. This data-centric approach enables healthcare professionals to access critical information, such as whether a patient has a chronic condition or if they have been admitted previously for the same cause. Such information proves invaluable in understanding a patient's condition and is crucial in emergency situations[9].

Another significant application of RFID in healthcare at BJC HealthCare is in the management of medicine inventory. The manual reordering process can lead to excess inventory or potential shortages. With RFID in place, the organization gains a real-time view of each medicine, including its location and expiration date. This system facilitates automatic reordering of medicine when stock levels are low, ensuring a more efficient and streamlined supply chain for medical resources. Overall, RFID technology plays a pivotal role in enhancing patient care, improving inventory management, and increasing the overall efficiency of healthcare processes at BJC HealthCare.

7. Advantages of Integrating RFID into Warehouse Management Systems

1. Real-time tracking and data collection

RFID technology allows for real-time monitoring of object movement and location within your warehouse. This capability is particularly valuable for tracking inventory, providing accurate and up-to-date information on stock quantities and their respective locations.

2. **Improved accuracy and speed**

Warehouse tasks, such as receiving and picking, can be executed with higher accuracy and efficiency using RFID. By scanning items during receipt or picking processes, manual data entry errors are minimized. This not only saves time but also enhances overall operational efficiency.

3. **Enhanced security and compliance**

RFID is instrumental in tracking the movement of hazardous materials, ensuring their proper storage and handling. Additionally, it plays a crucial role in monitoring access to restricted areas, thereby mitigating the risk of unauthorized access or theft. This not only contributes to improved security but also helps in maintaining compliance with relevant regulations and standards.

7. Conclusion

Organizations must adopt a strategic approach to own and manage information related to their assets and processes to ensure a return on investment. While third-party vendor-based solutions may have initiated RFID adoption, they are not sustainable in the long run due to a lack of standards, dependency issues, and reduced collaboration with trading partners. For achieving real-time, end-to-end traceability, a central Electronic Product Code (EPC) repository that integrates with enterprise systems and RFID infrastructure becomes a cost-effective solution, providing visibility when it matters most.

The use of RFID devices significantly enhances warehouse operations, ensuring optimal pace, data accuracy, and overall productivity through efficient resource utilization. RFID devices operate within a radio frequency framework to execute transactions in warehouses. SAP Extended Warehouse Management's (EWM) built-in RF framework allows customization of logical transactions and screens to align with specific business process requirements. User menus can be personalized based on assigned tasks, such as inbound, outbound, or internal processing tasks. Successful integration of RFID with SAP EWM requires domain knowledge of warehousing, expertise in warehouse management system functionality, integration with ERP systems, and proficiency in various phases of functional testing. This comprehensive approach ensures the design, testing, and deployment of an appropriate framework for RFID devices.

In conclusion, the integration of RFID with SAP EWM provides warehouse managers and supply chain professionals with an efficient solution to streamline operations, improve accuracy, enhance security, and optimize overall efficiency. Leveraging real-time tracking, data collection, and communication capabilities, warehouses can fully unlock the potential of RFID technology, elevating their warehouse management to new heights.

References

1. Stevie. An Introduction to RFID. SAP Blogs, 2006
2. Zougar Y. An Introduction to RFID. Infosec institute, 2018.
3. Vanam L. S/4HANA Embedded Extended Warehouse Management (EWM) overview. SAP Blogs, 2020.
4. Jones EC, Christopher AC. RFID in logistics-A practical introduction. CRC Press and Google Books, 2019.
5. LinkedIn community. What are the current and emerging RFID standards and how do they affect interoperability? LinkedIn Community.
6. https://help.sap.com/saphelp_ewm900/helpdata/en/15/b1b7a620e04c23ba2b543dcd0bcd0f/frameset.htm
7. https://community.sap.com/t5/supply-chain-management-blogs-by-sap/rfid-overview-and-embedding-in-sap-ewm/ba-p/13535919
8. Kargudri V, Muthyala R. How the Pharma Industry can optimize distribution performance with SAP EWM. Krypt Team, 2019.
9. Asset Infinity. 5 big brands that uses RFID Technology in business smartly. Asset Infinity, 2020.