

RFID for WIP & Warehouse Management

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Your hosts



Himadri Joy Bepari
Electrical Eng. & BI Analyst

- ✓ Responsible for Tableau Report
- ✓ Streamlit based Webpage
- ✓ Master's in Microsystem & Electrical Engineering

What is RFID?

Radio Frequency Identification

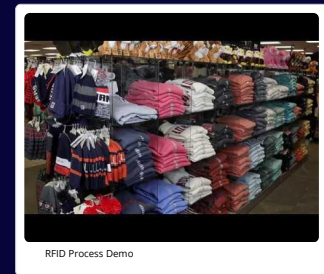
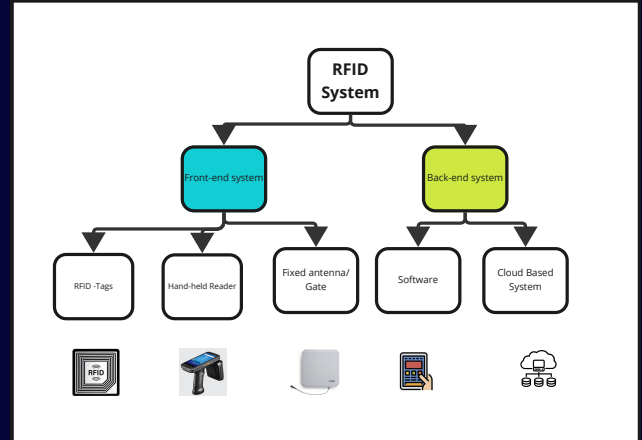
RFID is a form of wireless communication that uses the radio frequency portion of the electromagnetic spectrum to uniquely identify an object.

RFID technology is widely adopted over decade in multi-industries because it simplifies and automates processes with decreasing costs.



When an RFID reader is activated, it transmits a radio frequency signal to the surrounding area. If an RFID tag is within range of the reader, the radio frequency energy powers up the microchip on the tag. The microchip then uses this energy to transmit the data stored on the tag back to the reader. Each tag responds with a unique number.

The reader receives the data from the tag and finds the unique number, typically using a microprocessor. The data from the tag is then processed and sent to the cloud system.



Types of RFID

two main types of RFID tags:

1. **passive tags** do not have its own power source, and it relies on the energy transmitted from the reader to activate and transmit its data.
2. **active tags** have its own power source, typically a battery, and it can transmit data continuously, even when it is not in close proximity to the reader.

These tags operate at different frequencies, and are classified into three main types.

Most important one for us is **Ultra-High-Frequency (UHF) RFID tags**.

These tags operate at a very high frequency. UHF RFID tags are commonly used in applications such as supply chain management and asset tracking, where longer read ranges are required.

selection of right RFID tag?

- ④ What is the application?
- ④ Budget
- ④ What is the product made of? (e.g. glass, plastic, metal)
- ④ size of facility

Warehouse Management system important part of Supply Chain. Current WMSs have weaknesses:

1. no feature of real-time and automatic data retrieval. Instead, WMSs rely heavily on warehouse staff to record manually or through bar-code system.
2. Hence, incorrect information is inevitable because human error is account for around 80% of incorrect information

WMS based on RFID:

1. improves efficiency human errors are have been reduced by 90%.
2. real-time and automatic data synchronization features. For example, getting KPI data is easier.
3. achieve better inventory control. handheld reader to find out correct article, read n write tags.
4. RFID tags can embedded in the pallets/shelves/product.
5. mini-size, strong, penetrable & wireless readability, shape diversity, reusability and comparatively* low-cost.
6. by installing door tag reader it gives protection against article missings.
7. GPS based on WIFI Antenna can be also be with RFID.

accuracy rate & storage reach over 99.9% and time is shorted by 71% compared to the traditional way. The acceleration rate of speed in order-picking is 195%.*

Project Objective

List the objectives the project Aim for. Also called "Value Targeting"

- Improve inventory accuracy.
- reduce shrinkage and human errors.
- increased throughput & efficiency.
- precise location knowledge of any articles.
- Faster shipping.
- Reduce Manual Labour (workforce needed for barcoding, tracking, inventory management/record).
- Better customer service.
- Increased profit and revenue.
- Reduce stock-outs.
- prevents excess stock.
- generate live KPIS reports.

Business Decision

Financial Value is generated by: Cost Reduction, process improvement, and revenue enhancement

Benefits two type: Hard and Soft Benefits.

- Hard Benefits ex: removing a step from workflow > exact money value > determine cost for a specific element of the process.
- Soft Benefits ex: faster and better customer service > difficult to evaluate precisely.
Soft is good to have but Hard need to be prioritized

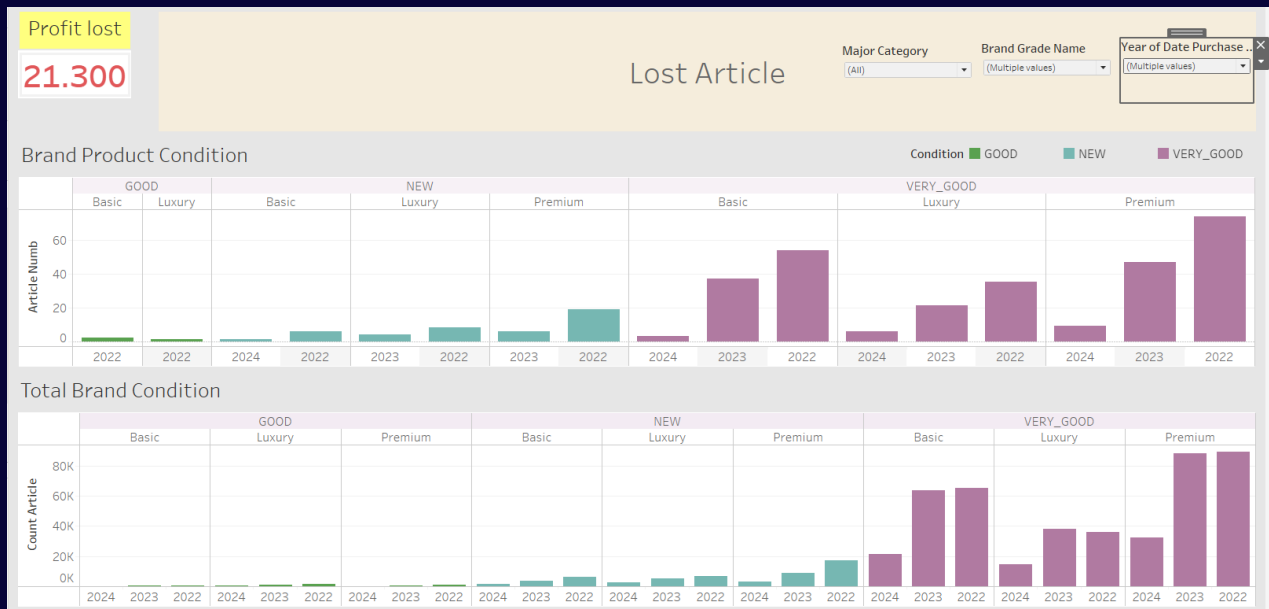
Cost Reduction:

key values of an RFID implementation is reduction of cost:

1. errors
2. shrinkage
3. inventory
4. handling
5. excess assets
6. misplaced assets & others

EX: if shrinkage is reduced by 40%(generally half or more)*, the cost of shrinkage is 3000€ per year then cost reduced in 5 years is 12000€

Tableau Report On missing Article



Process Improvement:

is accomplished in two completely separate phases.

1. replaces manual steps of identification, reconciliation, comparison and updating of vital records.
2. the project does not just reduce the the time sometimes it eliminates steps from the workflow altogether. It enables Cross-docking on a larger scale. RFID provides higher level of visibility and so it reduces the amount of inventory the organization must carry.

Revenue Enhancement:

1. Reduces out of stock and over stock of the product. It is better to gather the actual statistics for products and facilities.
2. Enables Data enhancement. RFID consists memory able to store variety of infos. EX: brand, major/minor category, timestamp, retail value. And so easy access to the necessary data and data synchronisation.
3. Easy to track, easier inventory record.

Costs

Business Justification process requires to predict the cost of the project. The major costs are:

1. RFID hardware: Readers and Antennas. Additional data storage capacity. one time cost. Antennas usually start from a minimum base of about 160€. Most UHF readers cost between €500 and €800, depending on the characteristics of the device.
2. Application Software: Application need to be supported by a software package. Software maintenance and upgrades are ongoing costs.
3. Middleware: important purchase expense. Key to use the system and integrating the data stream into business application.
4. Tags: largest single cost of the project. If tags UHF passive tags and not recycled. 96-bit passive tags can cost between €0.08 and €0.10 per unit. printable tag price goes up to about 0.15 €.
5. Installation and Configuration Services.
6. Cables and Connections.
7. Testing: Own testing or Outside testing service.
8. Training: ability to run software and operate the equipment is critical to your success. Vendor may provide knowledge transfer and own people provide the trainings or vice versa.

Risk

Any technology project carries risks:

1. the technology might not work as described.
2. project may take longer than expected.
3. unforeseen costs may arise.
4. works might not be able to execute as required.
5. external data sources might not be applicable or insufficient.
6. new workflow may not be as efficient, at least at first.
7. radio frequency interference.

Project Planning

Good project planning may take up to 40% of the entire project. Time spent getting the planning right will pay off in an enhanced chance for a successful project.

Documentation is very important.

Four types of documents must be prepared:

1. System Requirement List(SRL) of List of Objectives
2. Description document
3. Protocols
4. Project time table

This project has four Phases:

1. Phase 0: Business justification must be completed & approved before launching the project.
2. Phase 1: The Preliminary Planning Phase: create recommendation and documentation assembling initial project team, setting project objectives, developing a testing strategy.
3. Phase 2:
 - a. Step 1: Plan the pilot.
 - b. Step 2: Execute the pilot.
4. Phase 3:
 - a. Step 1: Plan technical integration.
 - b. Step 2: Execute technical integration.
5. Phase 4:
 - a. Step 1: Plan Rollout.
 - b. Step 2: Execute Rollout.

After each phase, review of activities and next step with team member, stakeholders is important.

Project Scope

Project Scope Document is a description of the project's boundaries. By listing RFID touchpoints gives an indication of the scope of the project. can be organized into three areas:

- Workflows. Which workflow will most be benefited by it? result will be initial Workflow list and will be substantially augmented as the project proceeds.
- Facilities. may include factories, warehouses, distribution centers, office buildings.
- System and networks. Determine where data flow will impact network performance, system performance and storage.

Pilot

Being success on Pilot is the the most important part. Keep it simple, plan it foremost, then execute. Recommendation is a single facility for the pilot. Select a facility in the same city as own base of operation. This enables to be very thorough in testing and assessments at a lower cost. UHF passive tags are recommended. Less cost, 10m range. Signal penetration better. Can be a particular articles at first.

Benefits of RFID in E-commerce

The use of RFID in your supply chain has many advantages for your business:

- **Online shopping.** The client has reliable information on the availability of the product, which helps to avoid a possible stock breakage.
- **Shipments.** Using RFID we can verify that shipments are correct in a matter of seconds, avoiding errors and improving customer satisfaction and loyalty.
- **Better Inventory.** With RFID it is possible to integrate the physical and online world and know at all times where each item is, thus facilitating the pick up of orders easily.
- **Reduction of Errors.** Tracking of goods is better. lesser human error and also error due to misplacement & shrinkage.

List of Skills

- Project Management.
- Current equipment knowledge.
- Current best practices in field.
- knowledge of tech, science and physics behind radio communication including antenna, placement and tuning. Absorption characteristics of various materials.
- knowledge of encoding of data, software, middleware, cloud system.
- sources of equipment and tags.
- company's internal process.
- company's IT networks and standards.
- Construction methods and techniques.

Lodz process:

i) Purchase Pre-check:

They are the first point of contact with the articles. Tags can't be applied before that. Probably they will be the responsible group to register and add tag to each article.

So no reduction of time or benefits can be generated from them.
Need some training. Not so different than tagging one barcode.

ii) Customer price agreement:

Articles are changed location multiple times, there is no full record of which article is where. The recording is manual and requires much time and so it is not done anymore. We lose clear view.

With RFID reader articles can be read in bulk. Record is automatic and data are centrally synchronised.

Warehouse process:

iii) Article Description

If quality good then all the description input can also be given to the RFID chip.

Category, brand, color, measurement

iv) Wrapping

Further tagging barcode or another tag is not necessary because clear line of sight is not necessary.

differentiation between returns and new-Ins would be easy.

Article placement would be easier. No manual scanning.

Precise location would be known so less article would be lost.

Record of the product is automatic so no manual inventory, which is done once a year. Article lost in between, Profit lost. (If any item is missing for more than 8months then profit lost)

better visibility during order pickup. All articles in a order basket easily put.

Better view how well article is performing.

Orders are verified easily, it shows if any item is missing or wrong item

less error. 100% customer satisfaction which leads to loyalty.

Readers can be desk-mount.

Tag price:

From Alibaba:

[Alibaba link](#)

100 - 999 pieces	1000 - 9999 pieces
US\$0.08	US\$0.07
10000 - 99999 pieces	>= 100000 pieces
US\$0.05	US\$0.02

We have on average of 99,533 article, Max 131055, Min 75577*
the average cost would be if we buy 100000 tags = 2000\$ = 1840€

RFID reader price:

Antenna from Alibaba:

[Alibaba link](#)

1 - 9 pieces	10 - 49 pieces
US\$150.00	US\$146.00
50 - 99 pieces	>= 100 pieces
US\$131.30	US\$121.20

Handheld from Alibaba:

[Alibaba link](#)

Minimum order quantity: 1 piece
US\$300.00 - US\$500.00

Access label performance

Continuous tag reading distance	≥15 meters	8dBi circularly polarized antenna, 30dBm output power, Standard E41 test card
Continuous tag writing distance	≥4 meters	
Tag recognition speed	≥100pcs/s	

RFID Antenna readers needed for the Lodz are 8
For Hamburg it is 2.

12 Readers are recommended.

Then price would be $12 \times 146 = 1752\$ = 1665\text{€}$

RFID Handheld reader 5 needed, would have one license
of software per RFID device.

4 for Lodz, 1 for Hamburg.

then Price would be $5 \times 300 = 1500\$ = 1395\text{€}$

The cost of middleware/depends on quota and provider.
Need to consult with them.

We already have data lakes from google.

The implementation costs, including installation, software integration, and labour, amount to €4000~5000. Over a three-year period, the store incurs an average annual maintenance cost of €500.

Then total cost over three year:

$$1840\text{€} \times 3 + 1665\text{€} + 1395\text{€} + 5000\text{€} + 500\text{€} = 14100\text{€}$$

~15000€

Profit lost in three years only due to items not found:

(generally inventory done in once in a year)

$$6511\text{€}(2023) + 13487\text{€}(2022) + 1121\text{€}(2024) = 21300\text{€}$$

Let's take 90% are recoverable. Then income increase

$$\text{could be} = 21300 \times 90\% = 19170\text{€}$$

Lost sales/miss-ships. Typically in a retail environment, if inventory is not available on the shelves, sales are lost as customers go elsewhere. For a manufacturer, what are the consequences (penalties, cancelled orders, etc.)

Inventory and search time. Many companies are often amazed at how much time is spent controlling inventory accuracy. How often are physical inventories taken? How long do these take? How many man hours are spent searching for missing inventory? Not only can RFID minimize the need for periodically counting inventory, it can also reduce the time to do so. Calculate the amount of wages spent on these processes and how the time might be better spent.

Search/audit costs (2 hrs./wk. @ €10) x52 =1040€/year

Ancillary Costs/year

- Penalties / Lost orders : €10,000
- Annual Inventory (24 manhours @ €10/hr.) x10 worker = €1600

Total currently = 1040 + 10000 +1600 = €13440

Search/audit costs (1 hrs./wk. @ €10) x52 =520€/year

Ancillary Costs/year

- Penalties / Lost orders : €1000
- Annual Inventory (8 manhours @ €10/hr.) x10 worker = €800

Total currently = 520 + 1000 +800 = €2320

Cost reduction = 13440-2320 = €11120

Then total cost reduction/Profit increase =
 $11120 + 19170 = \text{€}30290$

Needs to calculate ROI over three years.

Then ROI or $= 30000/15000 = 2$

it is said that ROI over three years is not significant then it is not a well investment. But this is well above 1, so there would be well positive impact.

Net Present Value (NPV):

it is a calculation where you determine if the projected financial benefits outweigh the projected costs. A positive result is favorable; a negative one is not. Determining the projected costs is rather simple.

$$\begin{aligned}\text{NPV} &= \text{Cost Savings over time} / (1 + \text{interest rate})^3 \\ &= (30000 - 15000) / (1 + 0.07)^3 \\ &= \text{€}12244.5\end{aligned}$$

$$\text{NPV}(i, N) = \sum_{t=0}^N \frac{R_t}{(1+i)^t}$$

Where

t – the time period you want to evaluate (the life of the project)

i – the interest rate that could be earned on an investment in the financial markets with similar risk.)

R_t – the net cash flow i.e. cash inflow – cash outflow, at time t .

*Market interest rate is projected to average 7% over the 3 year project life.

Net Present Value (NPV):

Thus, this project would have a positive benefit to the company, saving them €12244.5 over three years (assuming the interest rate stays at 7%). This investment can then be compared against other investments to determine relative worth.

*Market interest rate is projected to average 7% over the 3 year project life.