THE RFID PROFESSIONAL INSTITUTE

Professional Certificate Examination Curriculum

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PROFESSIONAL CERTIFICATE EXAMINATION CURRICULUM

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Introduction

Purpose

The purpose of this document is to provide candidates, tutors and examiners with an outline of the subject areas and content that are within the scope of the RFID Professional Institute's Professional Certificate examination. It is intended to help candidates prepare for the certification exam, and as a teaching aid for those looking to offer certification training.

Scope

This document covers all RFID-related subject areas that could be included as part of the Professional Certificate exam. It spells out the specific subject areas that will be covered.

Document Management

All versions of this document are managed and controlled by the RFID Professional Institute's president. That individual is the owner of the processes involved with managing this document, as well as future iterations of it, and is responsible for maintaining this document.

The Professional Certificate Exam

The Professional Certificate exam is the second level in the RFID Professional Institute's examinations. While the Associate Certificate exam tested the candidate's knowledge and understanding of RFID technology, including core terminology, the different types of RFID and how they work, standards and regulations, system components and the common applications for each type of RFID, the Professional Certificate exam focuses on the candidates knowledge of best practices for selecting the right type of RFID technology for an application, designing a solution, developing the business case and deploying the solution.

Passing the RFID Professional Institute's Professional Certificate exam demonstrates that a person has a detailed grasp of the core concepts of how the various types of RFID systems are deployed to solve a business problem. Candidates that have passed the exam have demonstrated, for instance, that they know when to use an active RFID system, instead of a passive system, how to select the appropriate components of a system, and how to determine whether the solution designed will deliver a return on investment. It does not mean that the certificate holder has detailed knowledge of, say, how to write an application program interface (API) to link RFID data to backend systems.

The RFID Professional Institute's certificates are authenticated by VerifyEd, a company that uses blockchain to track each certificate the institute has issued. Thus, potential employers can be sure that an individual's certificate is legitimate.

About the Exam

Delivery

THE EXAM IS DELIVERED ONLINE ONLY

Individuals can take RFID Professional Institute exams online via a company offering professional testing services (TestInvite). Once the exam starts, examinees can only open a single window in their browser, and no other applications may be running. The test-taker must complete the exam in a single sitting within 90 minutes.

Format

QUESTIONS

The exam consists of 75 questions divided into 12 sections, each of which tests the candidate's knowledge of one of the subject areas set out in this curriculum. Questions are multiple choice, true/false or matching. For multiple choice questions with more than one correct answer, the test taker will be informed to choose as many responses as apply. Candidates will receive partial credit for selecting one of two or three correct answers but will be deducted points for a wrong answer. For example, selecting one of two correct answers will result in half credit for that question. But selecting one right answer and one wrong answer will result in no credit, as the wrong answer will cancel out the credit for the right one.

Questions are presented randomly by the system within each section, and the order of the answers is randomized. Candidates may revisit questions they have previously answered or passed over.

TIME

For in-person testing at an event, candidates may start the exam any time after the proctor has told them to start or log in. Whether taking the exam in person or remotely, once candidates start the exam, they will have 90 minutes to answer all 75 questions. At the end of the exam period, no further input or revisions to any question will be possible. Candidates may complete the exam in less than the allotted exam period, but once they have exited the exam, they may not restart it, even if the exam period has not yet expired.

Passing Grade

The normal grade needed for passing the RFID Professional Institute's Professional Certificate exam is 70% of the weighted answers. However, this score is provisional and does not mean that candidates who have answered fewer than 70% of the questions correctly have not passed the exam. As with all academic and professional exams, there are occasions when the scores of a group of candidates indicate that a further normalization of the scores and associated pass level is required.

Candidates will typically be advised of their formal score and pass or fail grade within 14 days of taking the exam. Communication will be by email from the RFID Professional Institute's president advising candidates of their status. Candidates who have passed the exam will also receive a digital certificate from the RFID Professional Institute signed by the organization's president. This certificate is the only formal confirmation that a candidate has passed the exam. It is authenticated via blockchain and hosted by VerifyEd. Through this e-verify company, candidates can share their certificate on LinkedIn and other social media sites. If you have any exam-related questions, please send an email to contactus@rfidpros.org for assistance.

INTRODUCTION

Examination Scope

The examination for the Professional Certificate will cover 14 areas of RFID knowledge, outlined below. The breadth and depth of knowledge that candidates are expected to demonstrate for each of these subject areas is explained in more detail in the next section.

1. **DEFINING THE PROJECT'S PURPOSE AND REQUIREMENTS**

   Undertaking a structured problem assessment, identifying the root causes of the problem RFID is meant to solve, creating a cross-functional team to manage the project and engaging workers whose job will be affected by the introduction of an RFID solution

2. **CHOOSING THE RIGHT TECHNOLOGY: ACTIVE, PASSIVE, OR BATTERY-ASSISTED PASSIVE RFID**

   Determining when to use proprietary RFID systems vs. those based on open standards, when to use active, passive, or battery-assisted passive RFID, and the key factors to consider when choosing the appropriate type of RFID technology

3. **CHOOSING THE RIGHT PASSIVE OR ACTIVE RFID SYSTEM**

   Determining when to use LF or HF for short-range RFID applications, the right passive UHF RFID system for mid-range application, the right active RFID technology for long-range RFID systems, when to use battery-assisted passive RFID, hybrid systems (RFID and GPS, for example), sensor networks or alternatives to RFID

4. **DATA-ENCODING SCHEMES, MANAGEMENT, AND INTEGRATION**

   Determining when a project can use proprietary numbering schemes versus GS1 standards, EPC serial numbers, or ISO-based encoding schemes, as well as strategies for using

5. **SOLUTION DESIGN, PART 1: REQUIREMENTS AND HARDWARE**

   Articulating the project's problem and goal, policy requirements, regulatory requirements, user access, tag form factors, commissioning and applying tags, specifying the type of reader required for various read points, choosing external antennas and determining what peripherals are needed

6. **SOLUTION DESIGN, PART 2: CONNECTIVITY, DATA FLOW, AND USAGE**

   Determining electrical needs, communication network needs, capturing an item's identity and determining its location, capturing additional information, articulating how the data will be used, ensuring data security and customer privacy, changes to business processing, running a pilot and creating a rollout plan

7. **DEVELOPING THE BUSINESS CASE**

   Estimating the components' costs, determining additional costs, estimating the benefits, running a pilot to determine the return on investments and when to deploy a solution if there is no ROI

8. **PRE-DEPLOYMENT STEPS**

   Identifying who will deploy the RFID system, choosing the best location for the pilot, selecting and installing pilot equipment, managing change, validating the pilot results, updating the application requirements and creating a deployment plan

INTRODUCTION

9. DEPLOYING THE RFID SOLUTION

Infrastructure upgrades, equipment inventory taking and preassembly, installing the RFID readers, tagging items, backend integration and data verification

10. MANAGING CHANGE IN RFID DEPLOYMENTS

Why change management matters, building understanding and trust, key topics to communicate, training employees for the initial rollout, training new employees, continuous change-management strategy

11. POST-DEPLOYMENT STEPS

Ensuring long-term success, validating the return on investment, documenting soft benefits and unexpected benefits, expanding the rollout and introducing new applications, establishing feedback loops for continuous improvement

12. MAINTENANCE, SUPPORT AND TROUBLESHOOTING

RFID Supporting the RFID system, modifying the RFID system, troubleshooting

01

DEFINING THE PROJECT'S PURPOSE AND REQUIREMENTS

Defining the Project's Purpose and Requirements

Scope

This section covers two phases at the start of an RFID project: initiation and preparation.

Knowledge Tested

Candidates are expected to know the best practices involved with launching an RFID project.

PHASE 1: INITIATION

- Researching the Project's High-Level Scope
- Undertaking a Structured Problem Assessment
  - Identifying Root Causes
  - Mapping the existing process to identify visibility gaps
  - Analyzing current data flows
  - Determining the cost of current manual processes
  - Determining whether other companies are using RFID to solve a similar problem
- Precisely Defining the Problem and the RFID Project's Goal

PHASE 2: PREPARATION

- Creating a Cross-Functional Team of Stakeholders
- Choosing the Right Project Leader
- Engaging Those Who Will Use or Be Affected by the RFID System
- Revising the Project Goal, If Necessary
- Defining the Scope and What Constitutes Success
- Limiting the Project Scope
- Documenting the User Experience
- Defining What Data Needs to Be Captured, and Where
- Specifying the Application Requirements
- Validating the Application Requirements

Knowledge Not Tested

Candidates are not expected to know:

- Expected return on investment from various applications
- Specific financial assessment techniques, such as net present value

01

DEFINING THE PROJECT'S PURPOSE AND REQUIREMENTS

Sample Questions

1. **The first task in Phase 1 of an RFID project is to do which of the following?**

   A Identify root causes of the problem RFID is meant to solve

   B Undertake a structured problem assessment

   C Create a cross-functional team

   D Measure asset-utilization rates

2. **To help identify the root causes of the problem RFID is meant to solve, a company should do which of the following?**

   A Map the existing process to identify visibility gaps

   B Analyze current data flows and the quality of data

   C Determine the cost of current manual processes

   D All the other answers are correct

3. **It is important for a company to clearly define the RFID project's goal. Which of the following is a good example of a well-defined goal?**

   A Increase on-shelf availability in retail stores across all product lines from 60 percent to 95 percent or better

   B Reduce the amount of time nurses spend looking for equipment in a hospital

   C Reduce the number of lost or stolen parts bins at a manufacturing plant

   D Increase the accuracy of items to be shipped from a warehouse

ANSWERS: 1. B | 2. D | 3. A

02

CHOOSING THE RIGHT TECHNOLOGY: ACTIVE, PASSIVE, OR BATTERY-ASSISTED RFID

Choosing the Right Technology: Active, Passive, or Battery-Assisted RFID

Scope

This section will cover how to determine which of the different types of RFID systems—active, passive, or battery-assisted passive—are best for a specific application, as well as when to use open standards versus proprietary systems.

- Proprietary Systems vs. Open Standards
- Active, Passive, or Battery-Assisted Passive RFID
  - Making a list of what will be tracked
  - Determining the distance from which items or individuals will be tracked
  - Determining the required level of location accuracy
  - Grouping items according to the required tracking distance and location accuracy
  - Deciding whether you need to know the condition of assets or products
- The Costs of Transponders vs. Readers
- Other Factors to Consider
  - Asset size
  - Whether tags will be subject to harsh conditions
  - The need for real-time knowledge of asset locations
  - Whether other RF devices will operate in the RFID system's vicinity
  - The total cost of ownership
  - Data security
  - Protecting consumer privacy
  - The need for a backup identifier
- Narrowing Down the Options

Knowledge Tested

Candidates are expected to know the best practices for evaluating when to use the broad categories of RFID systems, their relative costs, and other factors described above.

Knowledge Not Tested

Candidates are not expected to know:

- The value of assets or item to be tracked or the potential benefits from tracking them
- The size of different assets or items to be tracked and how that impacts the choice of RFID transponders
- The different types of assets or items that companies might want to track
- Specific types of open-loop or closed-loop applications

02

CHOOSING THE RIGHT TECHNOLOGY: ACTIVE, PASSIVE, OR BATTERY-ASSISTED RFID

Sample Questions

1. **Which of the following are among the benefits of choosing an RFID solutions based on open standards? Choose as many as apply.**

   A They are generally less expensive since vendors must compete on price

   B A company is not locked into a single supplier

   C There is typically a greater supply than with proprietary systems

   D All the above

2. **Which of the following are among the key considerations when choosing one type of RFID system over another? Choose as many as apply.**

   A The distance from which the item will be tracked

   B The location accuracy required

   C The size of the facility in which items will be tracked

   D The types of backend systems that are already in use

3. **True or false? Active RFID systems are most often used to track and manage large, high-value assets over long distances (containers in a distribution yard, for instance, or gurneys at a hospital).**

   A True

   B False

ANSWERS: 1. D | 2. A AND B | 3. A

03

CHOOSING THE RIGHT PASSIVE OR ACTIVE RFID SYSTEM

Choosing the Right Passive or Active RFID System

Scope

In addition to demonstrating the ability to choose the right broad types of RFID technology—active, passive, battery-assisted passive or hybrid system—candidates must show that they can determine which specific technology within the broad segment of RFID is most appropriate. If, for example, it is determined that a passive RFID system is appropriate, when should a company use passive LF, passive HF or UHF, and when should they set up chokepoints versus zones to locate items? This section of the exam covers:

- LF or HF for Short-Range RFID Applications
  - Consumer applications
  - Data-transfer rate
  - Encryption
  - Form factors
  - Metal
  - Product availability
  - Standards
  - Tag emulation
  - Water
  - Explosive environments
- UHF for Mid-Range Applications
  - Cycle counts
  - Chokepoints
  - Zonal systems
  - Real-time location systems
- Choosing the Right Type of Passive UHF RFID
  - The layout of the facility
  - The size of the coverage area
  - The need for real-time data
- Active RFID for Long-Range Applications
  - Standards
  - Location accuracy
  - Distance
  - Data-transfer rates
  - High-metal environments
  - Explosive environments
  - Cost
  - Battery life
  - Sensor data
  - Ease of deployment
- Battery-Assisted Passive RFID Systems
- Hybrid RFID Systems
  - RFID and infrared (IR)
  - RFID and GPS
  - RFID and cellular technology
- RFID Sensor Networks
- Alternatives to RFID
  - Infrared (IR)
  - Ultrasound
  - 2-D barcodes

03

CHOOSING THE RIGHT PASSIVE OR ACTIVE RFID SYSTEM

Knowledge Tested

Candidates are expected to know:

- The various characteristics of different types of RFID systems and how they make them suitable for one application or another
- The form factors available for different types of RFID transponders
- The location accuracy of different types of RFID systems
- Whether data and communications are encrypted in different types of RFID systems
- The data transfer rates of different types of systems
- The effect of environmental conditions on different types of RFID systems
- How the size and layout of a facility can affect the choice of RFID system used
- The difference between cycle counts, chokepoints zonal systems and real-time location systems
- When to use battery-assisted passive RFID systems, hybrid systems and alternatives to RFID2

Knowledge Not Tested

Candidates are not expected to know:

- Specific encryption techniques used in different RFID systems
- The cost of specific products or types of RFID transponders

Sample Questions

1. A company looking for a short-range RFID technology for a consumer application might choose HF over LF for which of the following reasons?

A LF tags do not come in form factors that are needed for consumer applications

B Some HF systems support encryption, whereas LF systems do not

C Most cellphone handsets now have an embedded passive HF RFID reader supporting the HF-based NFC air-interface protocol

D The read range of LF systems is too short for consumer applications

2. Indicate whether the following statement is true or false: HF and LF transponders come in similar form factors, such as buttons, glass ampules and labels that can be stuck on items to be tracked.

A True

B False

3. Which of the following statements about LF and HF on-metal transponders is true?

A Passive LF and HF both have fewer performance issues around metal than passive UHF does

B LF transponders perform slightly better in or around metal than HF transponders

C LF systems cannot be used in or around metal

D HF systems cannot be used in or around metal

ANSWERS: 1. A, B AND C | 2. A | 3. A AND B

04

DATA-ENCODING SCHEMES, MANAGEMENT, AND INTEGRATION

Data-Encoding Schemes, Management, and Integration

Scope

Once an implementer has chosen the specific type of RFID system to use for its deployment, the next step is to focus on the data that will be collected and how it will be used to create business benefits. Candidates must demonstrate that they can determine the appropriate data format that will be used for the serial number in the transponders and decide what, if any, additional information needs to be stored in the transponder's microchip. They must also show that they can evaluate whether any additional data needs to be captured, and how to protect data and the privacy of users. Finally, candidates must demonstrate an understanding of the different strategies for using RFID data. These are the specific topics covered in this section of the exam.

- Data-Encoding Schemes
  - Proprietary numbering schemes
  - GS1 standards
  - EPC serial numbers
    - User memory
  - ISO-based encoding
  - Plain text
  - RAIN Company Identification Number
- Sensor Data
- User Privacy and Data Security
  - Authentication
- Strategies for Using RFID Data
  - Direct data integration
  - Standalone RFID system
  - Stand-beside RFID system
  - Data repository

Knowledge Tested

Candidates are expected to know:

- When a company can use a proprietary numbering scheme and when to use GS1 numbering schemes or other standards available
- The basics of how Electronic Product Code data is formatted
- The basics of encoding schemes established by the International Organization for Standardization (ISO)
- Methods for protecting RFID data transmitted between the tag and reader and options for protecting consumer privacy
- The various strategies for using RFID data that companies can adopt and when each is most appropriate

Knowledge Not Tested

Candidates are not expected to know:

- Specific formats for encoding schemes
- The specific functions of individual bits within the EPC encoding scheme
- The types of encryption used to protect RFID transmission
- The format of data different types of RFID readers produce

Sample Questions

1. Which of the following are among the schema options for encoding serialized data in the transponder's microchip that companies can adopt? Choose as many as apply.

- **A** Proprietary numbering scheme
- **B** GS1 standards
- **C** Data standards developed by, or promulgated by, the International Organization for Standardization (ISO)
- **D** Standardize UPC barcode numbering schemes

2. Proprietary serial numbers are suitable in which of the following scenarios?

- **A** A company wishes to track containers shared among itself and its customers
- **B** A company wishes to track containers within its own facilities
- **C** A company is asked to tag goods for a retail customer
- **D** Proprietary serial numbers cannot be used in any of the above scenarios

3. Companies should not use proprietary serial numbers in passive UHF RFID transponders for which of the following reasons?

- **A** UHF RFID transponders are based on standards; therefore, they should be encoded only with serial numbers based on standards
- **B** UHF RFID readers can only decode serial numbers based on existing standards
- **C** It's possible there will be duplicate numbers with tags using GS1 standards
- **D** There is no reason not to use proprietary serial numbers in passive UHF RFID transponders

ANSWERS: 1. A, B AND C | 2. B | 3. C

05

SOLUTION DESIGN, PART 1: HARDWARE

Solution Design, Part 1: Hardware

Scope

Once an implementor has chosen the right type of RFID technology, determined the appropriate data formats to use and an integration strategy, the next step is to create a solution design document — a blueprint for the RFID project. This section of the exam focuses on the primary issues that best practices suggest should be included in the solution design document, as well as the hardware issues that should be addressed.

This section of the exam will cover:

- Policy Requirements
- Regulatory Requirements
- Who Will Use the System, and How
- User Access
- Departments, Facilities, and Geographies Where RFID Will Be Used
- Choosing the Right Transponders
  - User memory
  - Geographies
  - Form factors
  - Metallic objects
    - Hard tags
    - Spacer tags
    - Flag tags
    - Printable labels
  - Size
  - Sensors
  - Privacy features
  - Security features
- Commissioning and Applying Transponders
  - Tag placement
  - Dealing with bad tags
  - Privacy
  - Tag application method
- Determining Where Data Needs to Be Collected
- Specifying the Type of Reader for Each Read Point
  - Fixed readers
  - Mobile readers
  - Handheld readers
- External Antennas
  - LF and HF antennas
  - UHF RFID antennas
  - Antenna cables
- Peripherals
  - Bollards
  - Electric eyes or photodetectors
  - Handheld readers
  - Light stacks
  - Mounting brackets
  - Multiplexers
  - Portals
  - RFID label applicators
  - RFID label printer-encoders
  - Robots
  - Shielding
  - Tunnels
  - Weatherproof enclosures

05

SOLUTION DESIGN, PART 1: HARDWARE

Knowledge Tested

Candidates are expected to know:

- What types of information related to company policies and government regulation should be included in the solution design document
- What information to include regarding users of the system and how they will access it
- Choosing the right transponder, based on standards, user memory, geography, form factors, size and other factors
- Issues to consider related to the commissioning and application of tags
- Issues related to tag placement, tag application methods, privacy
- Choosing the right type of reader for different read points
- Choosing the right type of antenna for passive RFID systems
- Determining what peripherals are needed for a specific solution

Knowledge Not Tested

Candidates are not expected to know:

- Specific regulations in any region or country
- Specific limits on RF power output
- Specific products on the market

Sample Questions

1. The solution design document should start by restating which of the following from the application requirements?

A The problem and the project's goal

B Policy requirements

C Regulatory requirements

D All the above

2. When spelling out the transponders to be used, the solution design document should indicate which of the following? Choose as many as apply.

A The amount of user memory required

B The vendor from which the tags will be purchased

C The form factors required

D The cost of the tags

3. For which of the following reasons is it important to indicate the countries and geographical regions in which the tags will be used?

A Different countries and regions have different power output limitations on tags, so not all tags work well in every region

B Different countries and regions have allotted different areas of the electromagnetic spectrum for use by RFID systems, so not all tags work well in every region

C Different countries and regions have different systems for storing data on the tags, so companies must prepare to use different serial numbers

D There is no need to state the different countries and regions in which the tags will be used

ANSWERS: 1. D | 2. A AND C | 3. B

06

SOLUTION DESIGN, PART 2: CONNECTIVITY, DATA FLOW, AND USAGE

Solution Design, Part 2: Connectivity, Data Flow, and Usage

Scope

This solution design document must also spell out details of how the RFID system will be powered, how data will be captured and routed to back-end systems and how the data will be used. This section of the exam covers:

- Connectivity
  - Electrical
  - Network
- Identifying Items and Capturing Tag Location
  - Identification
  - Location
- Capturing Additional Information
  - Direction
  - Status
  - Condition
- Software, Data Flows, and Storage
  - Standards
  - Data flows
  - Software
  - Middleware
  - Dedicated RFID software
  - Integration with existing applications
  - Storage
- Security and Privacy
  - Security
  - Privacy
- How the Data Will Be Used
  - Triggers
- Changes to Business Processes
  - Existing processes
  - New Processes
- Pilot and Testing Plans
- Rollout Plan
  - Big bang
  - By facility
  - By product category or asset class
  - By department
  - By project
- Support
- Training Requirements

06

SOLUTION DESIGN, PART 2: CONNECTIVITY, DATA FLOW, AND USAGE

Knowledge Tested

Candidates are expected to know:

- Options for powering readers and connecting them to data networks
- How to identify items from the serial number captured and how to determine the tagged item's location
- Additional information that a solution might require, including the status of an item, the direction it is moving and its condition
- Strategies for processing RFID data
- The types of software solutions might require
- Data security and privacy
- How data will be used, and any triggers or alerts software will generate based on tag reads
- Running pilots and testing the system
- The different strategies that can be adopted for rolling out an RFID solution

Knowledge Not Tested

Candidates are not expected to know:

- Providers of specific RFID software
- Specific functions of proprietary middleware and software
- The cost of middleware and software

Sample Questions

1. **The solution design document should spell out how RFID readers will be powered. Options include which of the following? Choose as many as apply.**

   A Wi-Fi

   B Power over Ethernet (PoE)

   C Dedicated electrical sockets

   D None of the above

2. **Readers installed in factories, warehouses, or retail stores can be connected to data networks by which of the following methods? Choose as many as apply.**

   A Wi-Fi

   B Bluetooth

   C CAT-5 Ethernet cables

   D ZigBee

3. **The solution design document should spell out which of the following? Choose as many as apply.**

   A Which database or databases will store the item description and associated RFID tag ID

   B Who will have access to the database

   C The company ID, part number, product ID, or other asset identifier that will link to the RFID tag's serial number

   D None of the above

ANSWERS: 1. B AND C | 2. A AND C | 3. A, B AND C

07

DEVELOPING THE BUSINESS CASE

Developing the Business Case

Scope

Candidates for the Professional Certificate must demonstrate that they understand how to estimate the costs of an RFID solution as well as the potential benefits. This section of the exam will cover:

- Estimating the Components' Costs
  - Tags
  - Readers
  - Antennas
  - Antenna cables
  - RFID peripherals
  - Shielding
  - Infrastructure
  - RFID software
  - Network expansion
  - Power supply
- Additional Costs
  - Installation
  - Software integration
  - Cost of capital
- Capital Expenditure vs. Operational Costs
- Estimating the Benefits
- Running a Pilot to Estimate the ROI
  - Establishing a baseline
  - The value of accurate data in operations
  - Soft benefits
- When There Is No ROI

Knowledge Tested

Candidates are expected to know:

- All the components that will be used in the system and that must be priced to determine the cost of the solution
- What additional costs must be factored into the ROI calculation
- How to determine what is a capital expenditure and what comes under operational costs
- How to determine the potential benefits of the RFID system
- How to treat soft benefits that don't contribute directly to the bottom line
- When it makes sense to deploy a solution even if there is no return on investment

Knowledge Not Tested

Candidates are not expected to know:

- The cost of specific components
- The cost of infrastructure upgrades needed before deploying an RFID solution
- Financial techniques for assessing the return on investment

Sample Questions

1. When estimating the cost of RFID hardware, which of the following should be considered, in addition to the number of transponders and readers required?

- **A** Network upgrades, if required
- **B** Shielding, if required
- **C** Peripherals, if required
- **D** All the above answers are correct

2. When estimating the cost of RFID software, it's important to consider which of the following? Choose as many as apply.

- **A** RFID middleware
- **B** RFID software applications
- **C** Third-party software integration
- **D** Cost of existing back-end systems the data will be fed into

3. Some unexpected costs that companies might incur when deploying an RFID system include which of the following? Choose as many as apply.

- **A** Running electric power lines with conduit to reader locations
- **B** Expanding the existing local area network to handle RFID data
- **C** Purchasing a license to operate RFID readers within a manufacturing facility
- **D** There are typically no unexpected costs when deploying an RFID solution

ANSWERS: 1. D | 2. A, B AND C | 3. A AND B

08

PRE-DEPLOYMENT STEPS

Active RFID System Components

Scope

Best practices dictate that companies should take some key steps prior to deploying an RFID solution. This section of the exam will cover:

- Identifying Who Will Deploy the RFID System
  - Using internal resources
  - Hiring a systems integrator
- Choosing the Best Location for the Pilot
  - Size and layout
  - Equipment
  - Products or assets
  - Business processes
  - IT systems
- Other Factors to Consider
  - When to track
  - How long to track
  - Establishing a baseline
- Performing a Site Survey
  - Electromagnetic interference
  - Electrical outlets to power readers
  - Networking connectivity
  - Physical characteristics
  - Asbestos
- Selecting, Installing, and Testing the Equipment
- Managing Change: Informing and Preparing Workers
  - The RFID system's purpose
  - What data will be collected
  - What data will not be collected
  - How the data will be used
  - How jobs will be affected
  - The effect on head count
  - The health risks
- Piloting the application
  - Establish what constitutes success
  - Make sure the pilot is manageable and controlled
  - Create a plan for how to use the RFID data during the pilot
  - Run the pilot long enough to evaluate the results
  - Document the new business processes
- Validating the Pilot Results
- Re-evaluating the Application Requirements, Updating the Business Case and Solution Design Document
- Creating a Deployment Plan
  - Funding
  - Schedule for any infrastructure upgrades
  - Schedule for vendor selection
  - Schedule for procuring hardware
  - Schedule for tagging the items to be tracked
  - Schedule for the installation of RFID readers
  - Schedule for software installation
  - Schedule for the integration of the RFID system with backend systems
  - Schedule for training employees
  - Technical support for the RFID solution
  - Target date for going live
  - Schedule for optimizing the system

08

PRE-DEPLOYMENT STEPS

Knowledge Tested

Candidates are expected to know:

- What internal resources will be required if a company chooses to deploy the RFID solution itself
- How to choose a systems integrator
- How to choose the best location for a pilot
- What should be included in a site survey
- Best practices for running a pilot
- What should be included in a deployment plan

Knowledge Not Tested

Candidates are not expected to know:

- Manufacturers of active RFID hardware
- Specifications for active RFID hardware on the market
- The cost of active RFID components

Sample Questions

1. Which of the following are among the questions companies should ask outside systems-integration firms before hiring one? Choose as many as apply.

A Have you carried out deployments in our industry?

B Have you deployed systems similar to the one we expect to use?

C Have you integrated RFID systems into the major software applications that our company uses?

D Do you guarantee the system will deliver a return on investment?

2. True or false? The most important factor when choosing an outside systems-integration firm is price.

A True

B False

3. Which of the following is the most important aspect of a site survey?

A Using a spectrum analyzer to determine whether there are any electromagnetic emissions from other RF devices, machines, or other sources present that could negatively impact the RFID system

B Using a signal detector to map the read zones in which data will be collected

C Removing any metal in the environment that could reflect radio waves and hinder the RFID system's performance

D None of the above

ANSWERS: 1. A, B AND C | 2. B | 3. A

09

DEPLOYING THE RFID SOLUTION

Deploying the RFID Solution

Scope

Once all the pre-deployment steps are complete, it's time to rollout the RFID system. This section of the exam will cover:

- Infrastructure Upgrades
- Inventory Taking and Preassembly
- Installing the RFID Readers
  - Conventional active RFID readers
  - Active RFID readers for RTLS
  - Passive LF and HF RFID readers
  - Passive UHF readers
- Tagging Items
- Backend Integration
  - Data verification

Knowledge Tested

Candidates are expected to know:

- What infrastructure upgrades might be required before RFID readers are installed
- Preparing RFID equipment for installation
- Basic issues related to the installation of different types of RFID readers
- Issues related to tagging items
- Issues related to integrating RFID data with backend systems

Knowledge Not Tested

Candidates are not expected to know:

- Specifics of installing RFID readers
- Specifics products that can be used in deployments
- Specific methods for filtering RFID data and integrating it into backend systems

09

DEPLOYING THE RFID SOLUTION

Sample Questions

1. **Which is the first step companies should take when deploying an RFID solution?**

   A Tagging items that will be tracked

   B Installing RFID readers in the proper locations

   C Upgrading the infrastructure, including the data network, in the facility where the solution will be deployed

   D Informing customers and supply chain partners that your firm will be deploying RFID

2. **Which of the following are among the items that can be installed before RFID readers are put in place? Choose as many as apply.**

   A Shielding to block electromagnetic interference from electric motors, RF devices, or other sources

   B Support structures for reader antennas

   C Enclosures for RFID readers

   D Light stacks, conveyor diverters, and other items to be triggered by RFID readers

3. **Which of the following are possible solutions to stop passive HF RFID tags from being read outside the area in which the company wants to capture tag data? Choose as many as apply.**

   A Switching to an LF system

   B Switching to transponders with smaller loop antennas

   C Reducing the gain of one or more reader antennas

   D None of the other answers are correct

ANSWERS: 1. C | 2. A, B, C AND D | 3. B AND C

10

MANAGING CHANGE IN RFID DEPLOYMENTS

Managing Change in RFID Deployments

Scope

Change management is critical in any RFID deployment because workers are often concerned that it will be used to monitor them, and if they don't embrace the system, it cannot deliver value. This section of the exam will cover:

- Why Change Management Matters
- Building Understanding and Trust
- Key Topics to Communicate
  - The RFID system's purpose
  - What data will be collected
  - What data will not be collected
  - How the data will be used
  - Impact on job roles
  - Effect on head count
  - Health and safety
- Training Employees for Initial Rollouts
  - Frontline workers
  - Indirectly affected roles
  - Basic maintenance
- Training New Employees
  - Onboarding programs
  - Decentralized vs. centralized training
  - Budgeting
- Training for System Upgrades
- Continuous Change-Management Strategy
- Ethical Considerations
  - Equal opportunity and nondiscrimination
  - Respect for privacy
  - Transparency and honesty
  - Informed consent
  - Appropriate use of content
  - Avoidance of manipulative tactics
- Cultural Sensitivity
  - Language and communication style:
  - Cultural norms and values
  - Religious and holiday observances
  - Historical and social contexts
  - Inclusive examples and case studies

Knowledge Tested

Candidates are expected to know:

- The key topics related to the RFID solution that should be communicated to employees
- Issues related to training frontline workers and those whose roles might be affected by the new system
- What types of things employees should be trained for
- Best practices for continuous change management related to the RFID system
- Ethical considerations

Knowledge Not Tested

Candidates are not expected to know:

- Specific issues that need to be communicated
- Timing related to training
- Details of the effect of RF energy on the body

Sample Questions

1. **Best practices suggest that the change-management aspect of an RFID solution begins at which point?**

   A When the company identifies the problem that RFID is to solve

   B When the company chooses which RFID system it plans to deploy

   C When the company is running a pilot

   D After the solution has been deployed

2. **Best practices suggest that early in the planning stages, companies should engage employees who will use the RFID system, or whose jobs will be affected by it. Which of the following are reasons for this? Choose as many as apply.**

   A It will help the company design a solution that will deliver value

   B It will ensure the system complies with government regulations

   C It will help employees embrace and use the system

   D It is not a best practice to engage employees in the planning stages of an RFID project

3. **Which of the following are among the information about a new RFID system that companies should share with employees? Choose as many as apply.**

   A What data will be collected and what data will *not* be collected

   B How the new system will affect their jobs

   C What the effect will be on head count

   D Whether there are any health risks from the new system

ANSWERS: 1. A | 2. A AND B | 3. A, B, C AND D

11

POST-DEPLOYMENT STEPS

Post-Deployment Steps

Scope

The work of the cross-functional RFID team does not end when the solution is deployed. The project must be managed continuously to ensure that it is functioning properly and delivering value and to manage any enhancements to the system.

This section of the exam will cover:

- How to Ensure Long-Term Success
- Validating the Return on Investment
- Summarizing the ROI Components
- Documenting the Soft Benefits
- Documenting Any Unexpected Benefits
- Expanding the Rollout
- Introducing New Applications
- Updating Documentation and Standard Operating Procedures
- Establishing Feedback Loops

Knowledge Tested

Candidates are expected to know:

- How to validate the return on investment from the RFID system
- What to include in the summary of ROI components
- What soft benefits and unexpected benefits might be delivered by the system and should be documented
- What issues to consider when expanding the RFID rollout
- Why the cross-functional team should not be disbanded after the rollout

Knowledge Not Tested

Candidates are not expected to know:

- Specific ROI metrics
- The value of specific soft benefits
- The value of specific unexpected benefits

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POST-DEPLOYMENT STEPS

Sample Questions

1. Indicate whether the following statement is true or false: Validating the return on investment from an RFID system is always straightforward.

   A True

   B False

2. Indicate whether the following statement is true or false: Companies should wait at least a month after turning on the RFID system to validate the return on investment, because it takes time to ensure the system is working properly.

   A True

   B False

3. Indicate whether the following statement is true or false: In most cases, companies will be able to determine within weeks if the RFID system is meeting the expected operational improvements, such as reducing out-of-stocks, lost luggage, or mis-shipments.

   A True

   B False

ANSWERS: 1. B | 2. A | 3. A

12

MAINTENANCE, SUPPORT AND TROUBLE-SHOOTING

Post-Deployment Steps

Scope

Like any company system, the RFID solution will require ongoing maintenance and support, and staff will have to troubleshoot any issues that arise. This section of the exam will cover:

- Supporting the RFID System
- Modifying the RFID System
- Troubleshooting
  - Environmental and physical factors
    - Environmental changes
    - Electromagnetic interference
    - Material and density issues of tagged products, packaging
    - Null spots
    - Tag orientation, placement
    - Reader placement
    - Multipath effects
  - Tag and hardware issues
    - Poor tag-read rates
    - Broken or defective transponders
    - Tag density issues
    - Tags falling off items
    - Read speed
    - Battery issues (active tags)
  - System-level and data integrity challenges
    - Software integration failures
    - Firmware incompatibilities
    - API misconfigurations
    - Ghost reads and stray reads
    - Poor location accuracy
  - Operational and human factors
    - Improper tagging procedures
    - Inadequate training
    - Unauthorized tag removal
    - Inventory-movement patterns
  - Infrastructure and connectivity issues
    - Antenna cable issues
    - Network latency
    - Power supply instability
- Best Practices for Maintenance and Support
  - Conduct routine system audits
  - Monitor the environment
  - Institute staff training programs
  - Set up escalation tiers
  - Document system performance
  - Build in redundancy

Knowledge Tested

Candidates are expected to know:

- What ongoing support and maintenance is typically required
- Troubleshooting issues related to environmental factors
- Troubleshooting tags and hardware issues
- Troubleshooting data integrity issues
- Troubleshooting human factors that might arise
- Troubleshooting connectivity issues

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MAINTENANCE, SUPPORT AND TROUBLE-SHOOTING

Knowledge Not Tested

Candidates are not expected to know:

- Hardware issues related to a specific company's products or a specific type of product
- Time required to resolve issues
- Costs related to resolving issues

Sample Questions

1. **Indicate whether the following statement is true or false: Maintenance, support, and troubleshooting are tasks that need to be performed at all stages of the RFID project.**

   A True

   B False

2. **Best practices suggest that early in the planning stages, companies should engage employees who will use the RFID system, or whose jobs will be affected by it. Which of the following are reasons for this? Choose as many as apply.**

   A Replacing readers that malfunction or become obsolete

   B Upgrading software that runs on fixed readers and handhelds

   C Upgrading middleware and/or RFID software applications that runs on servers

   D Answering support calls from users of the system who have questions or issues

3. **The support team might be required to make modifications to the RFID system for which of the following reasons? Choose as many as apply.**

   A To make it easier to use

   B To improve its functionality

   C To meet a request from a customer

   D To enable it to collect additional data

ANSWERS: 1. A | 2. A, B, C AND D | 3. A, B, C AND D

Preparing for Your Exam

What to study

You are likely to pass the exam if you have the following background:

- You've studied the subject areas set out in this curriculum
- You have five years or more experience deploying RFID solutions
- You have a basic understanding of the way different types of RFID systems are used
- You understand data provided by RFID systems
- You possess good knowledge of RFID deployment best practices

Some Steps to Take Before Undergoing the Exam

Study the subject areas outlined in this curriculum. Remember that the exam is not focused on a specific form of RFID. Exam-takers will be tested on different aspects of all types of RFID systems, including passive LF, HF and UHF RFID, as well as active systems and hybrid systems.

If you are an experienced RFID professional, then you may feel that it's unnecessary for you to review the curriculum subject areas. But we advise you against this approach because you will likely be tested on aspects of RFID and related technologies with which you have not become familiar in your career so far, and because RFID technologies and applications are constantly changing. This curriculum provides a structured list of everything that might be on the exam.

Resources

STUDY GUIDE

The RFID Professional Institute has created a detailed Study Guide that covers all the topics that might be included on the exam, plus some related topics that are not covered but will be of use to anyone involved with RFID. The study guide can be purchased by visiting the RFID Professional Institute's website.

WEBSITES

There is a great deal of free information about RFID technology on the Internet, though not all of it is accurate or up to date. Among the best sources of information are:

- RFID Journal: www.rfidjournal.com
- AIM: www.aimglobal.org

BOOKS

There are also numerous books about RFID, including:

RFID for Everyone, A Comprehensive Guide: RFID for Technicians, Engineers, Layman [sic], ***Installers and Field Service Engineers***
by Andre Smalling CET | Jan. 23, 2023

https://www.amazon.com/RFID-Everyone-Comprehensive-Guide-Technicians/dp/B0BVDLF534/

RFID FM: Radio-Frequency Identification Field Manual
by Tim Bryant | Oct. 14, 2021

https://www.amazon.com/RFID-FM-Radio-Frequency-Identification-Manual/dp/1736526731/

PREPARATION

The Insider's Guide to Working with RFID
by Suzanne Smiley | Jan. 1, 2020

https://www.amazon.com/Insiders-Guide-Working-RFID/dp/0578778777/

RFID Handbook: Technology, Applications, Security and Privacy
by Gordon Colbach | Dec. 29, 2018

https://www.amazon.com/RFID-Handbook-Technology-Applications-Security/dp/1792824270/

RFID Handbook: Fundamentals and Applications in Contactless Smart Cards, Radio Frequency Identification and Near-Field Communication
by Klaus Finkenzeller and Dörte Müller | Aug. 2, 2010

https://www.amazon.com/RFID-Handbook-Fundamentals-Identification-Communication/dp/0470695064/

IN-PERSON TRAINING

RFID4U runs in-depth training courses on RFID at its facility in California, several times a year. The training is not geared specifically toward passing the Professional Certificate exam, but it will help. For more information, visit www.rfid4u.com.