SOLUTION DESIGN DOCUMENT

3.1 To-Be Design of Price Tag Management Subprocess within "Prepare" stage of sales business-process.

To-Be Process Design Document for "Company" Retail Chain.

Project: integration of Electronic Shelf Labels (ESL) for Electronics retailer.
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Version: 3
Date(yyyy-mm-dd): 2025-06-12.

3.2 Objective.

To design and document the optimized price tag replacement subprocess within the "Prepare" stage of the sales business process using ESL. The proposed ESL hardware is assumed to include a physical interaction button (tap or hold) for basic operations such as switch off/on and reassignment process. The objective is to eliminate manual paper tag handling by providing automated price synchronization between the PDS and all ESLs across the retail chain, while ensuring full data accuracy, fast deployment, and operational scalability.

3.3 To-Be Process Description.

The optimized price tag management subprocess operates through automated ESL synchronization, eliminating manual printing, cutting and (re)placement activities. Store Staffs involvement is limited only to product reassignment tasks and exceptions (e.g. mismatch) handling.

Step-by-Step Flow:

1) Product Data Change Event: A data update (e.g., price, description) for any product ID (currently 6 digits, expanding to 7 digits in the future) is entered into the PDS and published.

2) ESL Device Status Reporting & Server Identification: Each ESL device transmits its current assignment (ESL ID, assigned product ID, and the last update timestamp) to the ESL Server via Zigbee protocol through ESL Base Station

3) Data Formatting and Push to ESL Devices: Based on the identified ESL devices' characteristics (e.g., dimensions, display templates) and the updated product information retrieved from the PDS, the ESL Server processes and formats the display data (including product name, details, new price, and the current 'last updated' timestamp). This formatted data is then pushed through ESL Base Station via Zigbee protocol to each respective ESL device.

4) ESL Display Update & Confirmation: Each ESL device refreshes its display within 1 minutes to show the updated product name, details, new price (this information received from PDS), its own ESL ID, and the 'last updated' timestamp.

5) Error Handling & Notification: If an ESL fails to respond or confirm the update within 2minutes, an alert is generated on ESL-server and sends into the store's admin console (and optionally via a notification bot).

6) Product Reassignment (Regular Task) – When staff need to change which product is displayed on a specific ESL, they perform the reassignment through the following methods:

- Via QR Scanner: Store staff presses (e.g. 2 times/for 5 seconds) on the physical interaction button which is on the ESL frame and: scans the QR code appearing on screen with their phone > sees current product in the Web-Interface > taps “Reassign” button > scans or enters a new product barcode/ID > click confirms > ESL Server reassign.
- Via Admin Panel: Store staff opens the ESL management page > enters the target ESL ID > accesses the same reassignment page > scan with a scanner or enters a new product barcode/ID > confirms > ESL Server reassign.

3.4 To-Be BPMN Diagrams.

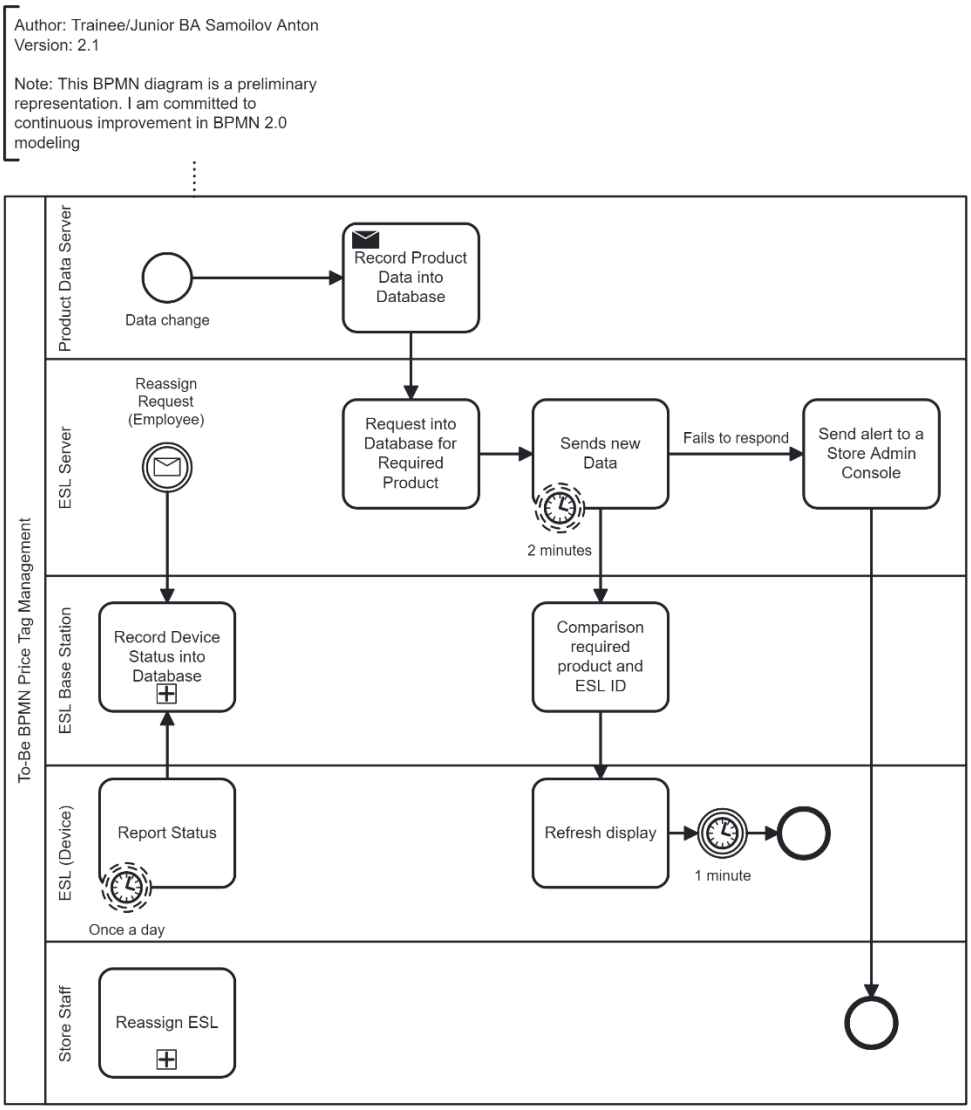

Image 4 – To-Be BPMN Price Tag Management Diagram

Image 5 – Record ESL Device Status on ESL Server

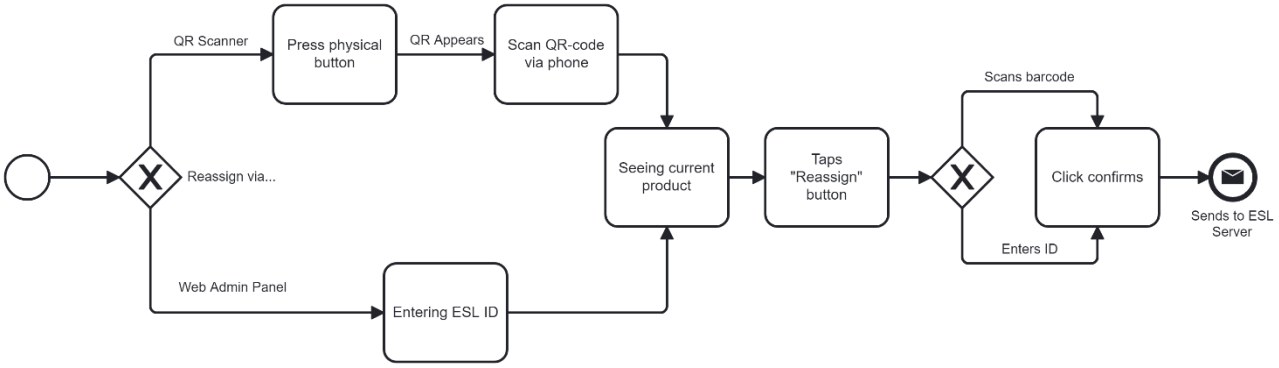

Image 6 – Reassign ESL(To-Be)

3.5 User Stories.

User story **1**:
As a store associate, I want ESL price tags to update automatically when product data changes so that I don't need to spend hours printing, cutting and placing price tags manually.

User story 2.1:
As a store associate, I want to press a physical button on the ESL device to display a QR-code, so that I can easily access the reassignment page for that specific ESL device.

User story 2.2:
As a store associate, I want to reassign ESL devices to different products by scanning ESL device QR code ID via smartphone, so that I can quickly update shown product.

User story 2.3:
As a store associate, I want to reassign ESL devices to different products by ESL ID via the admin panel, so that I can quickly update shown product.

User story 3:
As a retail chain, I want all ESL prices to show the product changed data in real time, so that price consistency is maintained across stores.
User story 4:
As a store associate, I want to quickly connect new ESL devices to the network, so that I can get them up and running with accurate pricing without delay.

3.6 Acceptance Criteria.

AC 1.1: Given an ESL device fails to receive a price update or confirm a successful update within the defined timeframe (e.g., 2 minutes, as per AC1.2), when

the system detects this failure, Then the system automatically generates an alert for that specific ESL device.

AC 1.2: Given an alert is generated for an ESL device sync failure (as per AC1.1), when the system alerts, Then store management receives a notification (e.g., in admin panel special page) containing the ESL ID, and type of failure.

AC 1.3: Given store management accesses a designated "ESL Errors" section in the admin panel, when they open this section, Then a list of all ESL devices with reported problems is displayed, including relevant details (e.g., last known status, time of failure).

AC 1.4: Given a sync failure for an ESL device has been resolved, when the ESL device successfully, Then the corresponding alert is automatically marked as resolved in the system and removed from the active alerts list.

AC 2.1.1: Given an ESL device displaying product information, When a store associate presses a designed phycial button on the ESL device (e.g. twice press, or hold for 5 seconds), Then ESL device displays a unique QR code on its screen.

AC 2.1.2: Given a QR code displayed on the ESL device (as per AC 2.1.1), When a store associated scans this QR code with mobile device's camera, Then the scanned QR code opens the Web-Interface ESL reassignment page with the specific ESL device's ID automatically pre-selected.

AC 2.1.3: Given a store associate attemteps to open the Web-Interface via scanned QR code and is not logged in, Then the Web-Interface redirects the associated to a login page.

AC 2.2.1: Given a logged-on and authorized store associate scans an ESL device's QR code using a mobile device's camera (opens the Web-Interface in a browser), When the Web-Interface processes the scan, Then the Web-Interface displays current product assigned to that ESL on a didecated "Reassign" page.

AC 2.2.2: Given the "Reassign page" is displayed (on the mobile device) the current product (as per AC 2.2.2), When the store associate selects an action to reassign the product, Then the Web-Interface provides options to either scan the barcode or manully enter its ID.

AC 2.2.3: Given the Web-Interface is ready to accept a new product ID via scan (as per AC 2.2.2), When the store associate scans the barcode of the new product, Then the Web-Interface successfully reassigns the new product to the ESL device, and the ESL immediately (within 5 seconds) displays the new product's information.

AC 2.2.4: Given the Web-Interface is ready to accept a new product ID via manual input (as per AC2.2.3), When the store associate manually enters a valid 6 or 7-digit product ID, Then the Web-Interface successfully reassigns the new product to the ESL device, and the ESL immediately (within 5 seconds) displays the new product's information.

AC 2.2.5: Given the Web-Interface is ready to accept a new product ID, when the store associate scans or enters an invalid (e.g., non-existent, incorrect format) product ID, Then the Web-Interface displays a clear error message (e.g., "Invalid Product ID") and allows the associate to retry.

AC 2.2.6: Given a product has been successfully reassigned to an ESL device, when the reassignment process is complete, Then the Web-Interface displays a confirmation message (e.g., "Reassignment Successful") and the ESL device displays the new product's data.

AC 2.3.1: Given an ESL device is operational and displaying product information, When a store associate observes the ESL screen, Then the ESL device's unique ID is clearly displayed on the screen (e.g., in a dedicated corner) alongside the product information.

AC 2.3.2: Given a store associate attempts to access the ESL management section of the admin panel, when the associate is not currently logged in or authorized, Then the admin panel redirects the associate to a login page.

AC 2.3.3: Given a logged-in and authorized store associate accesses the ESL management section of the admin panel, when the associate searches for or selects a specific ESL device ID, Then the admin panel displays the current product assigned to that ESL on a dedicated “Reassign page”.

AC 2.3.4: Given the “Reassign page” is displayed showing the current product (as per AC 2.3.3), when the store associate selects an action to change the product

(e.g., clicks a “Reassign” button), Then the admin panel provides an input field to manually enter the new product ID.

AC 2.3.5: Given the admin panel is ready to accept a new product ID via manual input (as per AC 2.3.4), When the store associate manually enters a valid 6 or 7-digit product ID, Then the reassignment successfully completes as per AC 2.2.4.

AC 2.3.6: Given the admin panel is ready to accept a new product ID, when the store associate enters an invalid (e.g., non-existent, incorrect format) product ID, Then the error handling proceeds as per AC 2.2.5.

AC 2.3.7: Given a product has been successfully reassigned to an ESL device via the admin panel, when the reassignment process is complete, Then the confirmation proceeds as per AC 2.2.6.

AC 3.1: Given a product data change is published in the PDS, when the ESL Server processes this update, Then the corresponding ESL device displays the updated product information within 1 minute of the data publication.

AC 3.2: Given an auto product data update event, When the ESL Server sends the update data to the required ESL devices, Then the server receives a confirmation of successful update for each respective ESL device.

AC 3.3: Given a product is displayed on multiple ESLs across different stores, when its product data is updated in the PDS, Then all ESLs displaying this product across all relevant stores must show the same, updated product information.

AC 4.1: Given a new ESL device is powered on for the first time, when the store associate scans the barcode located on the back of the ESL device using a mobile Web-Interface, then the device connects to the nearest ESL Base Station via Zigbee protocol.

AC 4.2: Given an ESL device is connected to the "Retail Chain" network, when the store associate initiates the pairing process, then the device is successfully registered in the ESL management system and ready to be assigned to a product.

3.7 Initial ESL Device Setup and Connection Process (AC 4.1 & AC 4.2)

This section outlines the detailed procedure for connecting a new Electronic Shelf Label (ESL) device to the "Retail Chain" Wi-Fi network and subsequently registering it within the central ESL management system via ESL Base Station.

Prerequisites:

- The new ESL device is powered on for the first time via a single press of its integrated physical button.
- The ESL device is currently in a discoverable and unconnected state, awaiting setup.
- The Store Associate possesses access to the designated mobile Web-Interface equipped with barcode scanning functionalities.
- The "Retail Chain" Wi-Fi network is actively operational and correctly configured within the store environment, ensuring robust connectivity.

Step-by-Step Flow:

1) ESL Device Power-On: The Store Associate initiates the ESL device by performing a single press of its integrated physical button. Upon activation, the ESL device's display typically shows a default status indicating it is unconnected or awaiting setup.

2) Associate Accesses Connection Interface: The Store Associate accesses dedicated connection functionality within the mobile Web-Interface on their smartphone (or navigates to the corresponding section of the admin panel).

3) Barcode Scanning: The Store Associate locates the unique barcode positioned on the back of the ESL device. This barcode, containing the device's unique ESL ID (with serial number), is then scanned using the mobile Web-Interface integrated scanner.

4) Web-Interface Transmits ESL ID: The mobile Web-Interface securely transmits the successfully scanned unique ESL ID (serial number) to the central ESL Server, via ESL Base Station connected to Wi-Fi network.

5) ESL Server Initiates Zigbee Connection: Upon receiving the ESL ID, the ESL Server commands the nearest ESL Base Station to initiate pairing with the

specific ESL device via Zigbee protocol. The Base Station broadcasts pairing signals within its Zigbee network coverage area

6) AC 4.1 Fulfilled: The ESL device successfully establishes a Zigbee connection to the nearest ESL Base Station, which serves as the communication gateway to the ESL server.

7) Network Architecture Overview:

- ESL devices communicate via Zigbee protocol (low power, mesh network)
- ESL Base Station/Gateways serve as bridges between Zigbee network and store's local network
- ESL Server receives data from Base Station via Ethernet/Wi-Fi store infrastructure
- Typical coverage: 1 Base Station per 100-200 ESL devices depending on store layout

8) ESL Device Registers with Server: Following a successful Wi-Fi connection, the ESL device automatically transmits its unique ID and current operational status to the ESL Server via ESL Base Station. This action initiates the device's formal registration within the ESL management system.

9) ESL Server Records Device Status: The ESL Server records the device's newly acquired status as "connected" and "unassigned" within the central ESL management system's database. This step partially fulfills AC 4.2, as the device is now successfully registered in the system.

10) Associate Initiates Product Assignment: From within the same mobile Web-Interface, the Store Associate can now proceed to assign the newly registered ESL device to a specific

3.8 Process Transformation Summary

Key Process Price Tag Management Changes:

Aspect	As-Is (manual)	To-Be (automated)

Price Updates	ERP>copy>print>cut>manual placement	Data server>ESL Server>ESL Base Station>ESL
Time Required	~25-240+ min	~1-2 minutes for reassignment
Staff Involvement	All available staff until done	Minimal: Exception handling
Error Risk	High due to manual process	Near-zero
Scalability	Limited by manual Capacity	Unlimited (network-based

Eliminated Activities:

- ERP navigation and revaluation copying
- Admin panel uses for Formating and Printing
- Paper printing and manual cutting
- Store walkthrough for manual tag placement
- Error corrections
- Repeated labor as a making revaluation for same product during week

New Activities:

- ESL product reassignment
- Exception monitoring
- System performance oversight

3.9 Benefits Realization.

Quantified Improvements:

- Time Savings: 95% reduction in daily price management time
- Error Reduction: Near-elimination of pricing discrepancies
- Staff Optimization: daily free for customer service
- Cost Elimination: 80% less paper, ink, or cutting supply expenses
- Process Reliability: Automated sync ensures consistency

Strategic Advantages:

- Real-time promotional campaign deployment
- Easy-scalable pricing operations across multiple locations
- Enhanced customer experience through accurate pricing
- Competitive positioning as technology-forward retailer

3.10 Implementation Considerations.

Technical Requirments:

- Reliable store network infrastructure for ESL Base Station connectivity
- Strategic placement of ESL Base Station for optimal Zigbee coverage throughout store PDS and ESL integration development
- ESL Base Station installation and configuration for Zigbee mesh network
- New ESL-server for sync between PDS and ESL
- New database for ESL-server
- Agreement and adding/replacing new formats (size) for Price Tags into ESL-server
- New threads architecture for the whole process
- Staff training on reassignment procedures

Change Management:

- Transition from manual to automated mindset
- New formal and non-formal role definitions for price management tasks
- Exception handling procedure establishment
- Performance monitoring system setup

Success Metrics:

- Price update competion time (<1 minute)
- System uptime and reability (>99%)
- Error notification response time (<2 minutes)
- Staff time allocation optimization
- Pilot stores management feedback about team focus and free time

3.11 Next Phase Recommendations

- Technical Specification Development - Define detailed ESL-PDS integration requirements
- Vendor Selection - Evaluate ESL system providers based on their solution capabilities, including support for barcode-initiated device connection, programming physical button and management software integration.
- Pilot Implementation Planning - Prepare 2-store pilot deployment strategy
- Staff Training Program - Develop reassignment and exception handling procedures
- Performance Monitoring Setup - Establish KPIs and tracking mechanisms