Process Design Document (PDD)

# Retail Innovations Inc. — Inventory Automation

## 1. Business Process Overview

Retail Innovations Inc. relies on manual inventory data entry, with warehouse staff recording stock counts by hand and entering them into Excel spreadsheets. This outdated process is prone to transcription errors, delays in reporting, and frequent stockouts (RetailWire, 2022). There is no automation in place for restock alerts or proactive inventory management.

## 2. Automation Objectives

The automation aims to:  
- Eliminate manual errors and standardize data entry (Tayab & Li, 2024).  
- Reduce processing time from 45 minutes per day per warehouse to under 5 minutes.  
- Auto-flag low inventory levels and send alerts for timely replenishment.  
- Maintain a clean, consistent inventory file with deduplication and preprocessing.  
- Deliver accurate, actionable inventory reports with minimal human intervention.

## 3. As-Is Workflow (Manual)

Current Process:  
1. Physical stock counts are recorded on paper.  
2. Data is manually keyed into Excel.  
3. Files are reviewed by supervisors.  
4. Inventory reports are created manually.  
5. There is no automated threshold check for reorder points.  
  
**Challenges:**  
 Manual entry introduces inconsistencies and error propagation (RetailWire, 2022). There is no version control or audit logging. Additionally, the lack of real-time alerting limits proactive restocking, leading to lost sales and operational delays.

## 4. To-Be Workflow (Automated)

A modular Python-based workflow will be implemented with key automation tasks including:  
- Loading CSV data (extract.py)  
- Data cleaning and validation (process.py)  
- Threshold evaluation and restock flagging (alert.py)  
- Output generation and optional alert delivery (update.py)  
- Full pipeline orchestration (main.py)  
  
This aligns with best practices in RPA design and Python-based ETL automation (Tayab & Li, 2024; Python Software Foundation, 2024).

## 5. Data Description & Assumptions

Data Source: Synthetic dataset (inventory\_raw.csv) created using the Faker library.  
Columns: SKU, Description, Location, OnHandQty, ReorderPoint, UnitCost.  
Logic:   
- ReorderQty = max(0, ReorderPoint - OnHandQty)  
- OnHandQty may be negative or missing in edge cases.  
- Duplicate SKUs are resolved by keeping the latest entry.  
  
These assumptions simulate real-world scenarios often found in retail inventory systems (Tayab & Li, 2024).

## 6. System Requirements

Programming Language: Python 3.9+  
Libraries: pandas, numpy, python-dotenv, logging, Faker  
Tools: VS Code, GitHub, GitHub Copilot  
Input Format: CSV file  
Output Options: CSV or JSON (extendable to API/Email endpoints)  
  
The use of open-source tools allows for transparent development and cost-effective scalability (Python Software Foundation, 2024).

## 7. Risks & Mitigations

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| **Risk** | **Mitigation Strategy** |
| Incorrect assumptions in fake data. | Generate multiple test cases; validate schema and anomalies. |
| Alert delivery failure | Log to file; simulate fallback method (e.g., print instead of email) |
| GitHub conflicts or broken commits | Use feature branches, commit messages, and periodic pull requests |
| Downstream use of unvalidated data | Include preprocessing validation and schema checks |

Rigorous logging and defensive coding practices reduce operational risk and increase maintainability (Tayab & Li, 2024).

## 8. KPIs & Metrics

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| **Metric** | **Baseline (Manual)** | **Target (Automated)** |
| Processing Time | ~45 min/day | ≤ 5 min/day |
| Error Rate | ~15% | < 2% |
| Alert Latency | None | ≤ 1 minute |
| Report Accuracy | Variable | ≥ 98% |
| Cost Savings | $500/month (estimated) | $500+ recoverable per site |

Goal: Achieve ≥ 90% reduction in time spent and ≥ 80% reduction in data errors within the first quarter of deployment (Tayab & Li, 2024).

## 9. References

RetailWire. (2022). Why retail still struggles with out-of-stocks. Retrieved from https://retailwire.com  
Tayab, M., & Li, H. (2024). Automating inventory processes using open-source tools. International Journal of Applied Automation, 12(1), 55–70.  
Python Software Foundation. (2024). pandas documentation. https://pandas.pydata.org