ENTERPRISE SAAS PLATFORM MANUAL

Manufacturing Inventory Management System

Complete End-to-End User, Operator & System Administration Guide

System Capabilities & Architecture Matrix

The Manufacturing Inventory Management System (IMS) is a multi-tenant, enterprise-grade operating system designed specifically for discrete and batch manufacturing organizations. Engineered with strict transactional integrity, an immutable stock movement ledger, bi-directional genealogy tracing, and automated procurement workflows.

Append-Only Stock Ledger
Mathematical single source of truth; zero overwrite mutations on inventory balances.

Bi-Directional Lot Genealogy
Instant recursive recall simulations spanning raw materials to customer orders in <1 second.

Dual-Authorization Governance
Segregation of duties for purchase approvals and stock adjustments above threshold.

Multi-Agency White-Label Engine
Independent tenant branding, customizable facility terminology, and theme palettes.

Document Reference: IMS-OPS-MANUAL-V2.4
Default Tenant: Apex Industrial Solutions (APEX)
Release Classification: Production Operations Ready

Version: 2.4.0 (Enterprise)
Published: October 2026
Security Level: Controlled Internal Document

Table of Contents

1.0 Enterprise System Overview & Architecture **Page 3**

1.1 Monorepo Structure & Tech Stack Page 3

1.2 Core Security Architecture & Append-Only Invariant Page 3

1.3 Multi-Tenant Agency Model & Dynamic Terminology Page 4

2.0 Authentication & Access Control **Page 5**

2.1 Login & Organization Selection Page 5

2.2 Multi-Factor Authentication (MFA / TOTP) Page 5

2.3 Token Rotation & Session Family Revocation Page 6

2.4 RBAC Roles & Permissions Matrix Page 6

3.0 Core Navigation & Dashboard **Page 8**

3.1 Executive Command Center Page 8

4.0 Master Data Management **Page 9**

4.1 Items, SKUs & Multi-Level Bills of Materials (BOM) Page 9

4.2 Approved Supplier Directory & Component Mappings Page 11

4.3 CSV Bulk Import & Dry-Run Validation Engine Page 12

5.0 Warehouse & Stock Ledger Operations **Page 13**

5.1 Warehouse Location Hierarchy: Depots, Zones & Bins Page 13

5.2 Real-Time Stock Balances & Available-to-Promise Page 14

5.3 The Append-Only Stock Movement Ledger Page 15

5.4 Inter-Bin & Inter-Facility Stock Transfers Page 16

5.5 Stock Adjustments & Threshold Approval Workflow Page 17

5.6 Physical Inventory Cycle Counting & Variance Posting Page 18

6.0 Procurement & Inbound Fulfillment **Page 19**

6.1 Purchase Order Lifecycle & Line Item Costing Page 19

6.2 Segregation of Duties PO Approval Queue Page 20

6.3 Goods Receiving & Receiving Bin Intake Page 21

6.4 Three-Way Match: PO, Receiving & Vendor Invoice Page 22

6.5 Supplier Performance Scorecards Page 23

7.0 Manufacturing Operations & Production Execution Page 24

7.1 Work Order Management & Shortage Verification Page 24

7.2 Component Consumption: Backflushing vs Manual Issue Page 25

7.3 Production Output Posting & Scrap Segregation Page 26

7.4 Shop Floor Yield Analytics & Scrap Trends Page 27

8.0 Sales Order Processing & Fulfillment Page 28

8.1 Sales Orders & Available-to-Promise (ATP) Verification Page 28

8.2 Soft Allocations & Walking-Route Pick Lists Page 29

8.3 Packing Slips, Dispatch & RMA Return Workflows Page 30

9.0 Traceability, Quality Control & Recall Simulator Page 31

9.1 Lot & Batch Management with FEFO Allocation Page 31

9.2 QC Hold, Quarantine & Release Authorization Page 32

9.3 Recursive Bi-Directional Genealogy (Recall Simulator) Page 33

9.4 Expiry Alerts & Individual Unit Serials Page 34

10.0 Demand Forecasting & Automated Replenishment Page 35

10.1 Historical Demand Aggregation & Forecast Models (SMA/SES) Page 35

10.2 Safety Stock, Reorder Point (ROP) & Reorder Queue Page 36

10.3 Pareto ABC Consumption Value Analysis Page 37

11.0 Financial Reports & Operational Analytics Page 38

11.1 Inventory Valuation: FIFO, LIFO & Weighted Average Cost Page 38

11.2 Stock Aging & Dead Stock Identification Page 39

11.3 Operational KPIs, Excel/PDF Exports & Recurring Schedules Page 40

12.0 System Administration, Theme Studio & Training Page 41

12.1 User Management, Facility Access & RBAC Scoping Page 41

12.2 Theme Studio: Live Branding & Terminology Customization Page 42

12.3 In-App Interactive Training Administration & Analytics Page 43

12.4 In-App Notifications Center & Operational Triggers Page 44

1.0 Enterprise System Overview & Architecture

The Manufacturing Inventory Management System (IMS) is engineered as an enterprise-grade system of record. In modern manufacturing, inventory discrepancies represent immediate financial, operational, and regulatory liability. Every physical movement of raw materials, work-in-progress (WIP), and finished goods must be traceable, auditable, and mathematically consistent.

1.1 Monorepo Structure & Tech Stack

The platform is structured as a unified monorepo managed via PNPM workspaces, guaranteeing complete type safety from database models to frontend React views:

- **Backend (`@ims/backend`):** Built on NestJS 10 and Node.js. Handles business logic, authentication, RBAC authorization guards, transactional stock ledger operations, and REST APIs.
- **Frontend (`@ims/frontend`):** Single Page Application (SPA) built with React 18, Vite, and TypeScript. Uses pure Vanilla CSS with CSS custom properties (variables) for fast rendering and comprehensive white-label dynamic theming.
- **Shared Core (`@ims/shared`):** Canonical TypeScript types, Zod validation schemas, and system enums shared seamlessly across backend and frontend layers.
- **Database & ORM:** PostgreSQL 16 utilizing Prisma ORM with strict foreign-key relational integrity, transactional ACID guarantees, and database-level append-only triggers.

1.2 Core Security Architecture & Append-Only Invariant

> **ARCHITECTURAL FOUNDATION: THE APPEND-ONLY LEDGER**
>
> Stock quantities are never stored as mutable numbers overwritten in place. Current stock is ALWAYS a derived sum calculated from the immutable `stock_movement` ledger table. Database grants enforce INSERT-only permissions for the application user.

Every mutating operation is recorded in the `audit_log` table via an automated interceptor. The log captures the user ID, timestamp, target entity, action, client IP, before-value, and after-value snapshots. This provides complete audit readiness for ISO 9001 and 21 CFR Part 11 regulatory compliance.

1.3 Multi-Tenant Agency Model & Dynamic Terminology

IMS features native multi-tenancy with organization scoping on every query. The application includes a runtime **Terminology Mapping Engine** that adapts terminology according to tenant industry conventions:

Standard Term	Apex Industrial Solutions (APEX)	Vanguard Dynamics Corp (VANGUARD)	Purpose in Manufacturing
Plant	Facility	Site	Parent operational physical location
Warehouse	Depot	Hub	Storage building within a plant
Item	Component	Material	Tracked part, assembly, or SKU
Supplier	Vendor	Partner	External sourcing vendor

Standard Term	Apex Industrial Solutions (APEX)	Vanguard Dynamics Corp (VANGUARD)	Purpose in Manufacturing
Work Order	Production Run	Build Order	Shop floor manufacturing job

2.0 Authentication & Access Control

Security begins at the authentication boundary. The IMS implements zero-trust authorization with defense-in-depth across every API endpoint and frontend route.

2.1 Login & Organization Selection

Users authenticate using their corporate work email and password. During authentication, the user selects their assigned **Organization / Agency** context. Passwords are hash-verified using **Argon2id** (memory-hard, resistant to GPU/ASIC cracking).

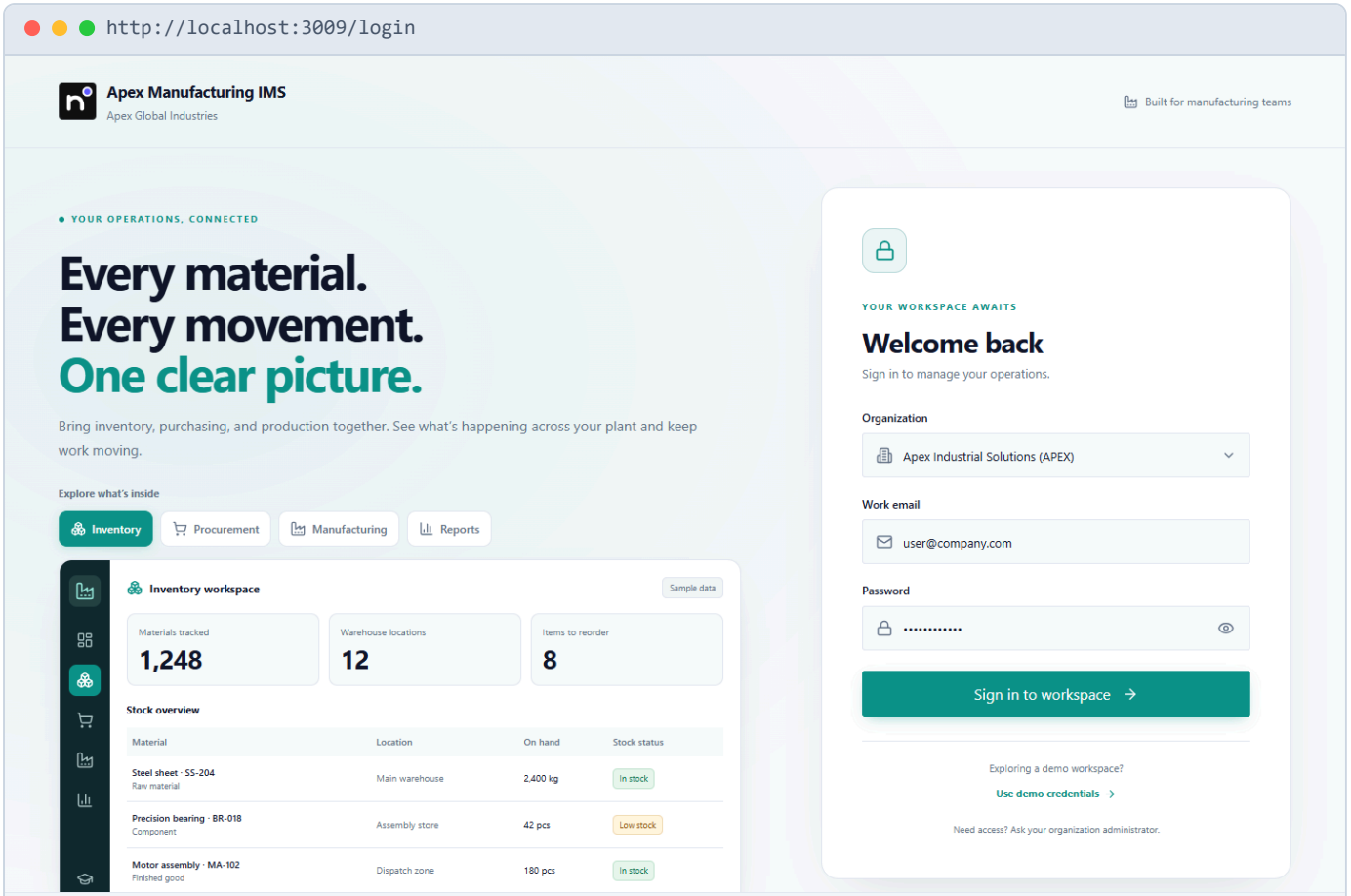


Figure 2.1: Multi-tenant login interface with organization selection and credential verification.

2.2 Multi-Factor Authentication (MFA / TOTP)

Multi-Factor Authentication is enforced for high-privilege roles (Admin, Finance/Auditor) and configurable per tenant. It utilizes Time-Based One-Time Password (TOTP) algorithms compliant with RFC 6238 (compatible with Google Authenticator, Microsoft Authenticator, and hardware tokens).

2.3 Token Rotation & Session Family Revocation

Authentication sessions utilize short-lived **JWT Access Tokens (15-minute expiration)** held in browser memory and a long-lived **Refresh Token (7-day lifespan)** stored in an `HttpOnly`, `SameSite=Lax`, `Secure` cookie.

> **REPLAY ATTACK DETECTION**

> On every refresh request, the refresh token is rotated. If an already-rotated token is presented again (indicating token interception), the backend automatically invalidates the entire session family, logging out all active devices associated with that token tree.

2.4 RBAC Roles & Permissions Matrix

The platform seeds seven standard manufacturing roles. Access is governed by server-side guards denying access by default:

Role Name	Target User Persona	Permitted Resources & Actions	Operational Boundaries
Admin	System Administrators, IT Directors	ALL Resources: `create`, `read`, `update`, `delete`, `approve`, `export`	Unrestricted organizational oversight; user provisioning, branding, and system configuration.
Warehouse Manager	Inventory Controllers, Warehouse Leads	`stock`, `stock_movement`, `item`, `plant`, `report`: All Actions	Stock adjustments, transfer authorizations, cycle count reviews, warehouse layout administration.
Warehouse Staff	Forklift Operators, Floor Clerks	`stock`, `stock_movement`: `read`, `create`	Floor bin transfers, goods receipt scan intake, pick list execution, cycle count input.
Procurement	Buyers, Sourcing Specialists	`supplier`, `purchase_order`, `item`: `read`, `create`, `update`	Vendor onboarding, PO draft creation, receiving reviews. Cannot approve own PO above threshold.
Production	Plant Supervisors, Line Leads	`work_order`, `bom`, `item`, `stock`: `read`, `create`, `update`	Work order planning, shortage reviews, material issue, good/scrap output posting.
Finance / Auditor	Cost Accountants, Quality Auditors	`report`, `audit_log`, `purchase_order`, `stock`: `read`, `approve`, `export`	Valuation review (FIFO/LIFO), 3-way invoice match exception approvals, immutable audit review.
Read-Only	Executives, External Stakeholders	All Resources: `read`	Read-only query visibility across catalog, stock levels, orders, and dashboards.

3.0 Core Navigation & Dashboard

Upon successful authentication, users enter the primary workspace. The interface features a collapsible sidebar, contextual search, facility switcher, and live operational widgets.

3.1 Executive Command Center

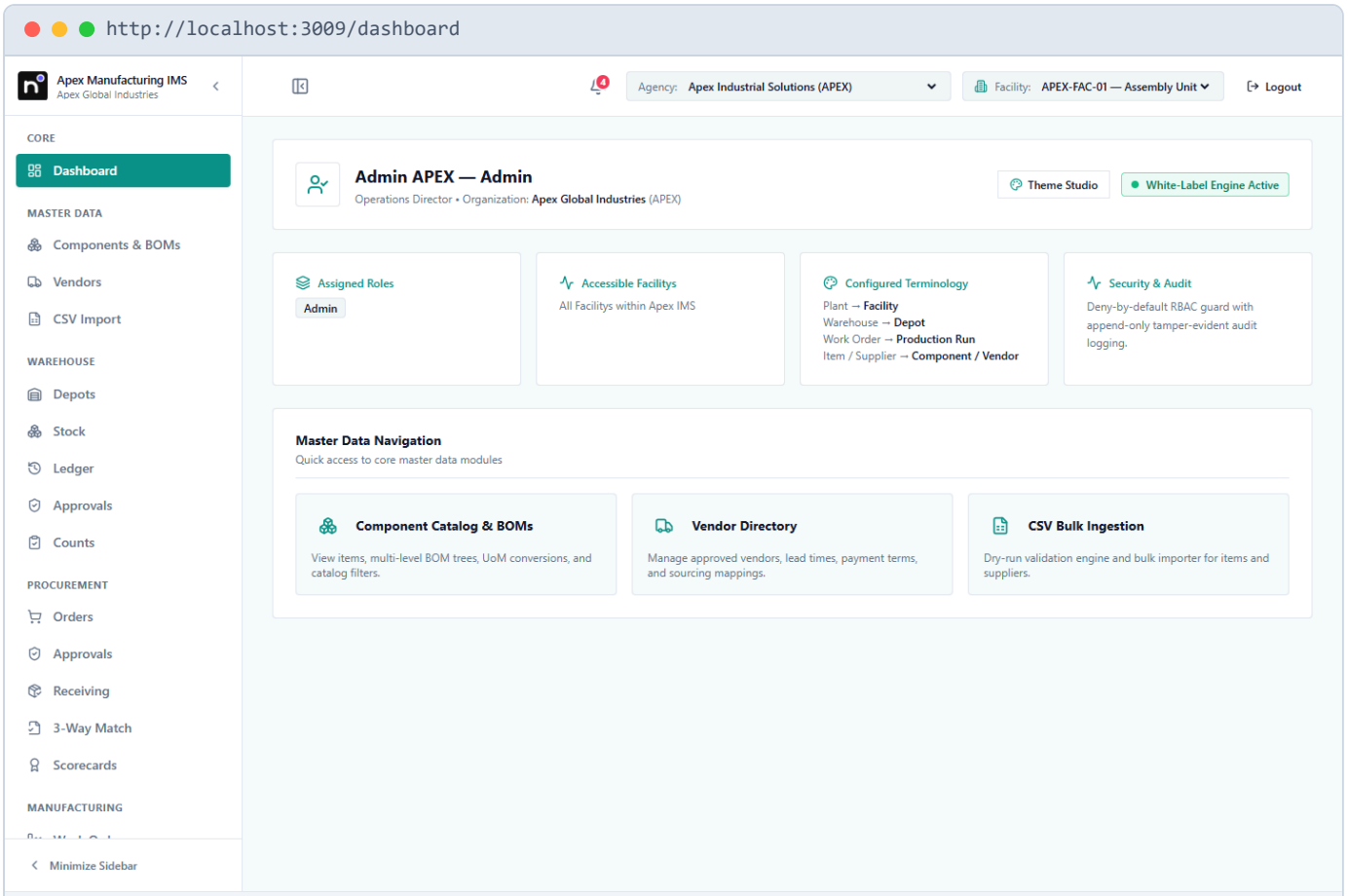


Figure 3.1: Command center dashboard showing live telemetry, user context, assigned facilities, and master data shortcuts.

The dashboard provides instant visibility into operational metrics:

- **User Profile Card:** Shows the active user, primary role, assigned agency branding, and quick link to the Theme Studio.
- **Assigned Facilities:** Displays facilities scoped to the user. All ledger queries and inventory transactions are strictly filtered to the currently active facility.
- **Configured Terminology Summary:** Confirms active terminology mapping (e.g. Component vs Item, Vendor vs Supplier).
- **Master Data Navigation:** One-click shortcuts to Component Catalog & BOMs, Vendor Directory, and CSV Bulk Ingestion.

4.0 Master Data Management

Master data is the foundation of manufacturing integrity. Every purchase order, work order, and stock movement relies on accurately configured items, bills of materials, and verified suppliers.

4.1 Items, SKUs & Multi-Level Bills of Materials (BOM)

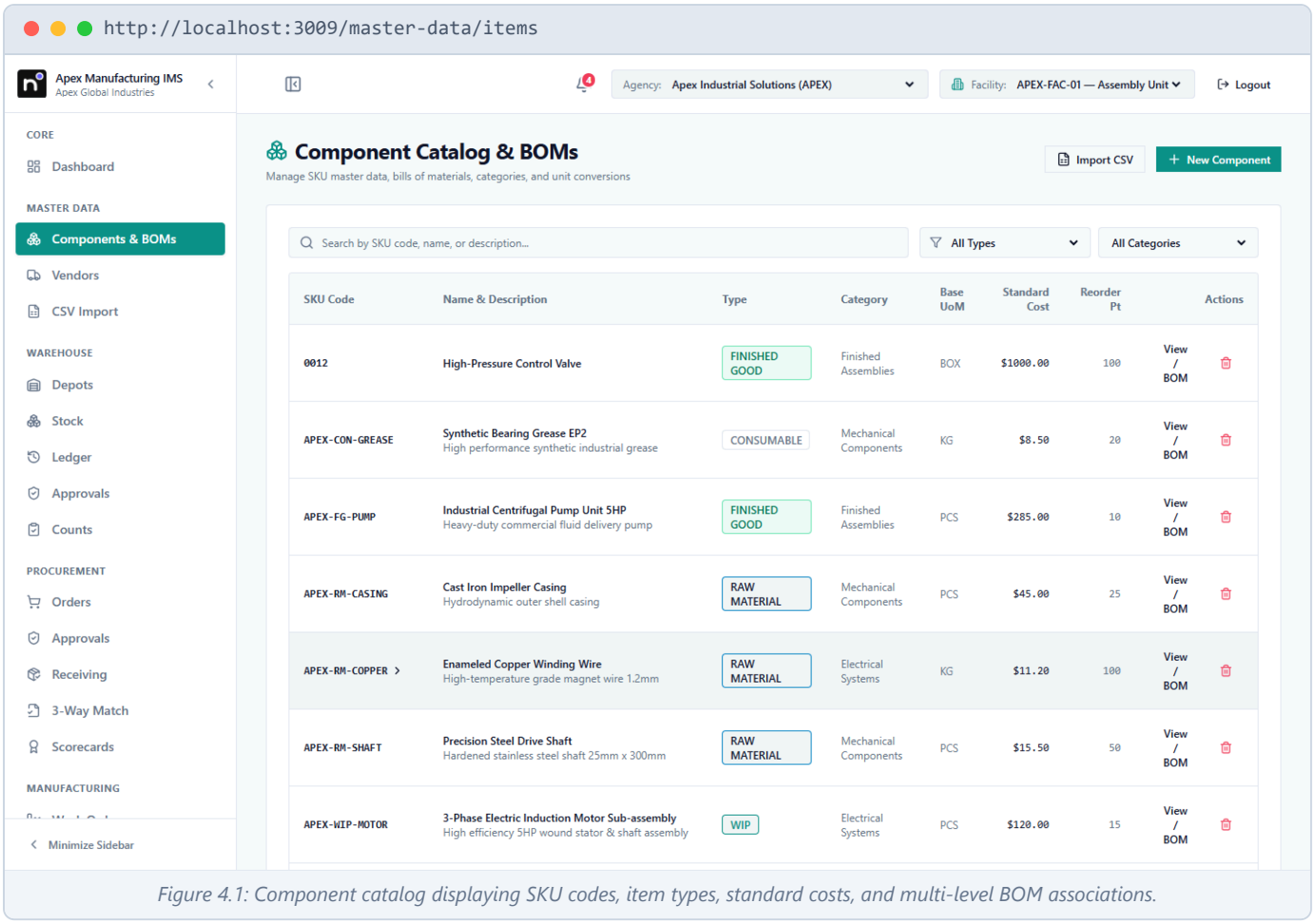


Figure 4.1: Component catalog displaying SKU codes, item types, standard costs, and multi-level BOM associations.

Item Types:

- `RAW_MATERIAL`: Inbound materials purchased from vendors (e.g. steel sheets, copper wire).
- `WIP` (Work-in-Progress): Intermediate sub-assemblies built on the shop floor that are consumed into higher-level assemblies.
- `FINISHED_GOOD`: Final manufactured items packaged and ready for customer fulfillment.
- `CONSUMABLE`: Non-BOM operational supplies (e.g. lubricants, packaging wrap).

> **BOM VERSIONING INVARIANT**
>
> Bills of Materials (BOMs) in IMS are immutable once marked `ACTIVE`. Any structural engineering change generates a new version (e.g. v2). Historical work orders always retain reference to the exact BOM version they were produced against, guaranteeing historical yield accuracy.

4.2 Approved Supplier Directory & Component Mappings

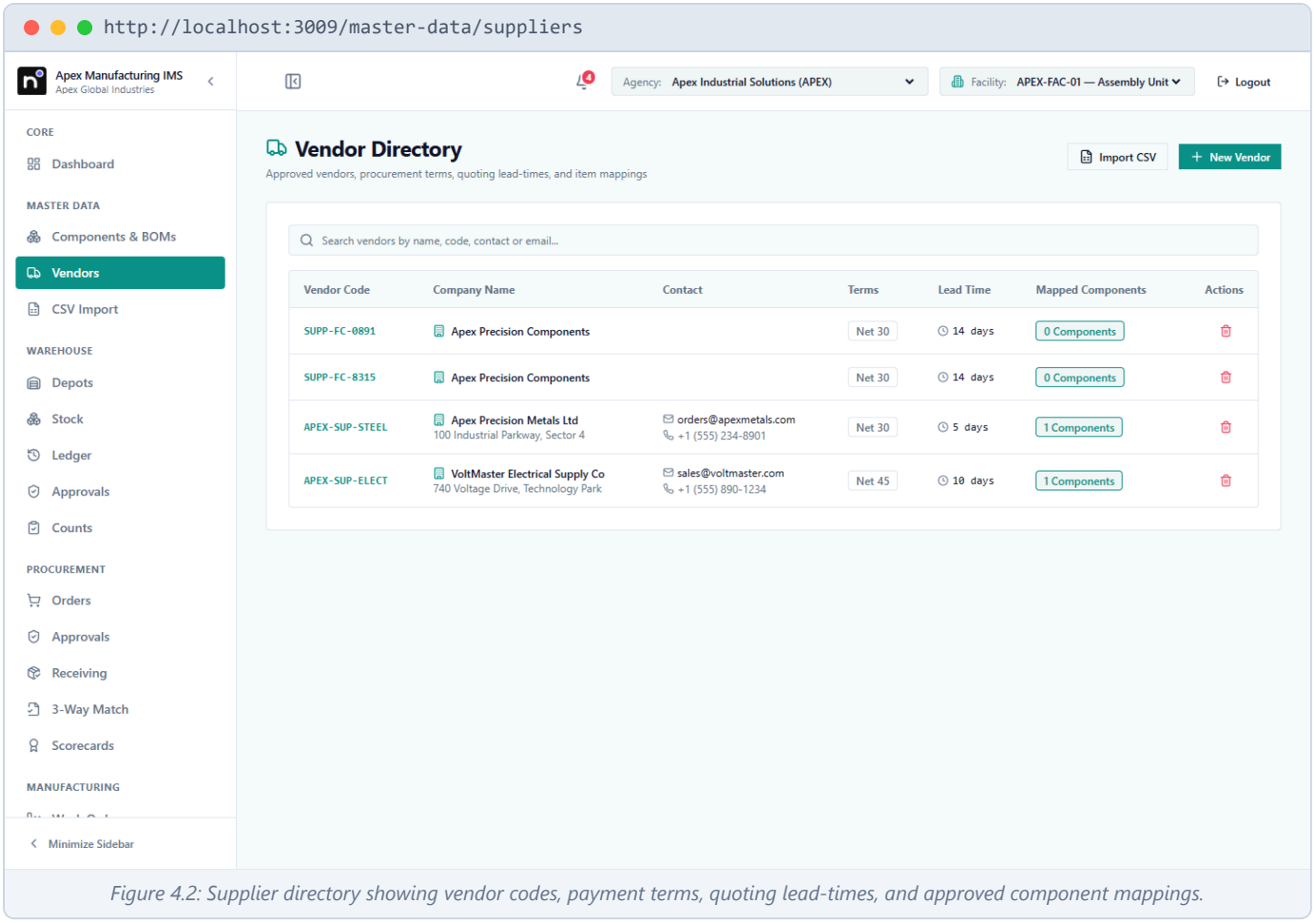


Figure 4.2: Supplier directory showing vendor codes, payment terms, quoting lead-times, and approved component mappings.

Procurement managers link approved vendors to specific raw materials with negotiated unit costs, minimum order quantities (MOQ), and standard lead times in days. Multiple vendors can be ranked by preference.

4.3 CSV Bulk Import & Dry-Run Validation Engine

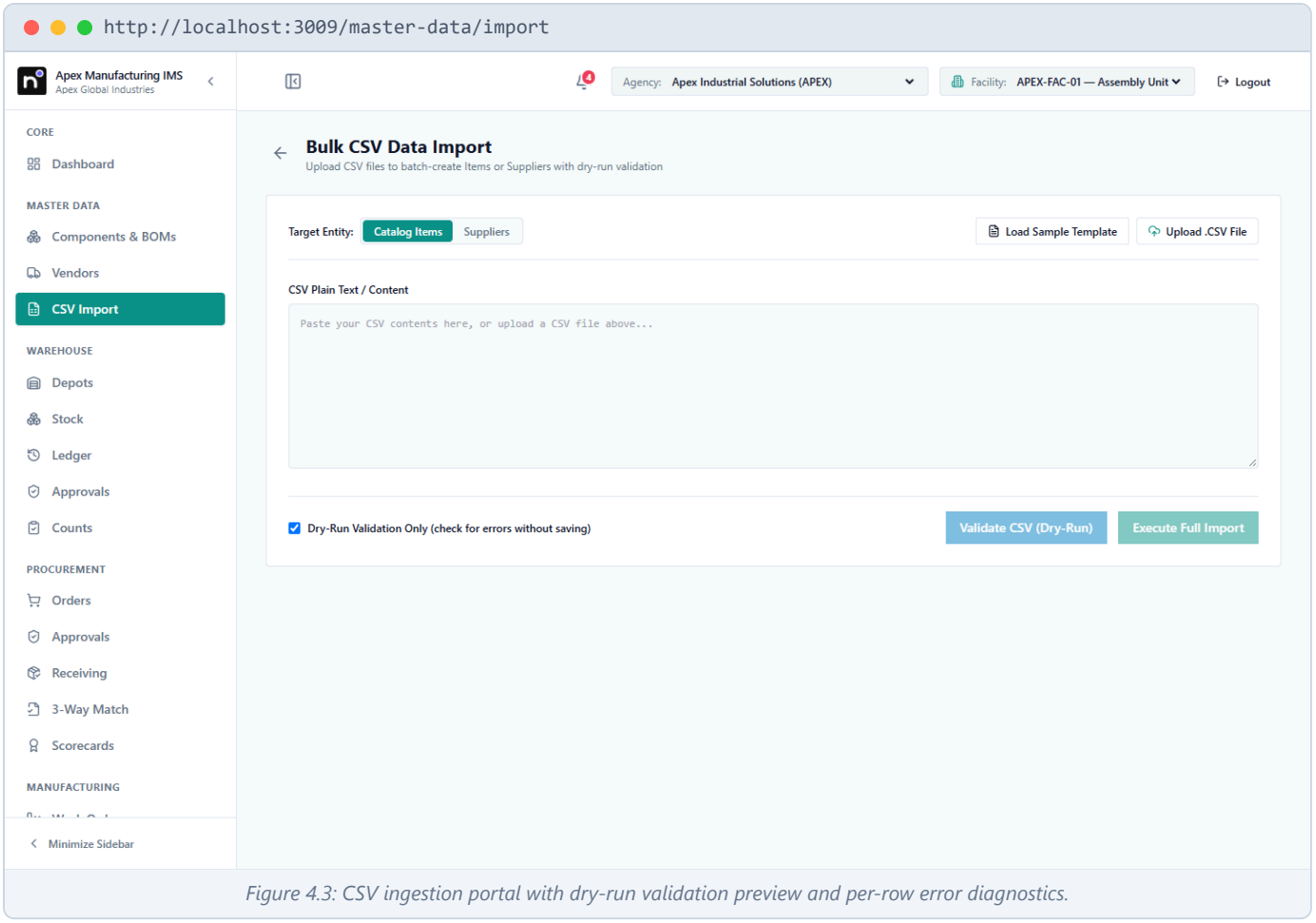


Figure 4.3: CSV ingestion portal with dry-run validation preview and per-row error diagnostics.

Step-by-Step CSV Bulk Import Workflow:

1. **Download Template:** Download the pre-formatted CSV template for Items or Suppliers.
2. **Upload & Dry-Run:** Upload the filled CSV file. The system parses all rows in-memory and validates SKU uniqueness, UoM conversions, and foreign keys.
3. **Review Diagnostics:** Inspect the validation summary. Any bad rows are flagged with specific cell-level error messages. Zero partial commits occur on failure.
4. **Execute Commit:** Once all rows validate, click "Confirm Import" to persist records inside a single transactional block.

5.0 Warehouse & Stock Ledger Operations

The warehouse module manages physical inventory locations, immutable ledger transactions, stock adjustments, and cycle counting routines.

5.1 Warehouse Location Hierarchy: Depots, Zones & Bins

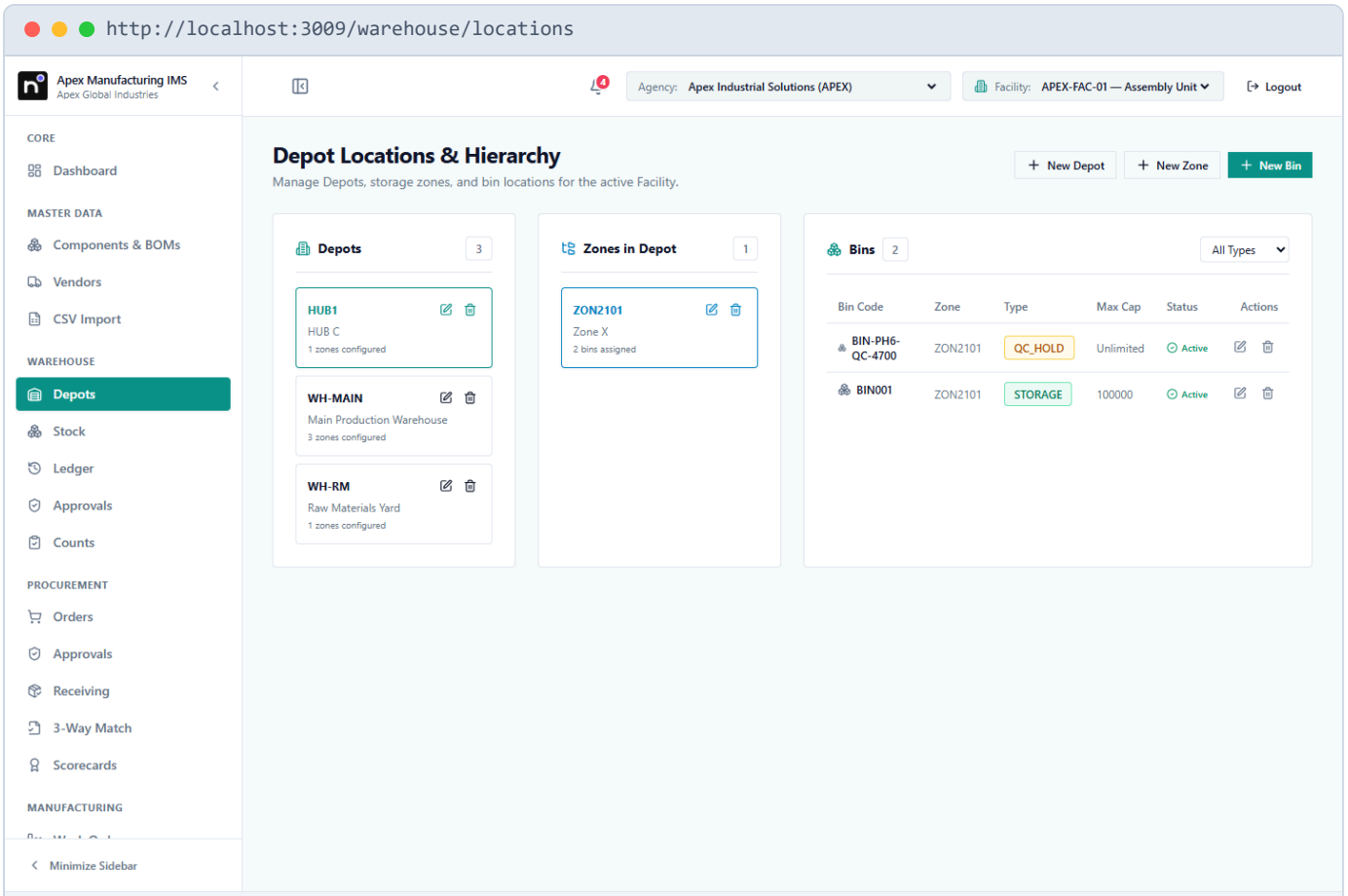


Figure 5.1: Multi-level warehouse location hierarchy showing depots, storage zones, and individual bins.

Locations are structured hierarchically: **Facility → Warehouse / Depot → Zone → Bin**. Bins specify dedicated operational purposes:

- `RECEIVING`: Staging bins for inbound goods awaiting inspection or putaway.
- `STORAGE`: Standard pallet racking or bulk storage locations.
- `PICKING`: Forward pick locations optimized for sales order allocation.
- `QC_HOLD`: Quarantine bins physically and digitally locking defective or pending lots.
- `SHIPPING`: Outbound staging areas for packed orders awaiting freight dispatch.

5.2 Real-Time Stock Balances & Available-to-Promise

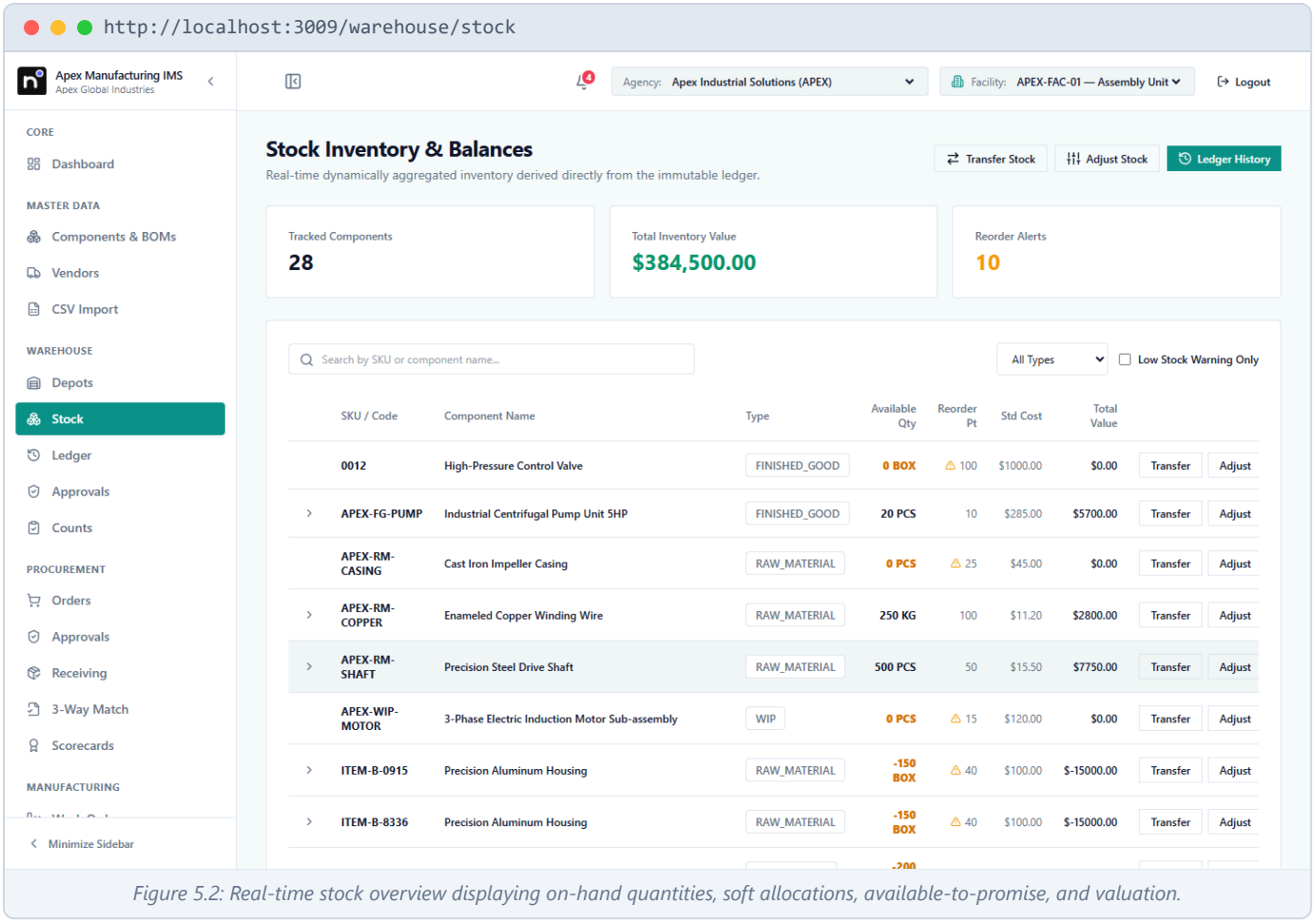


Figure 5.2: Real-time stock overview displaying on-hand quantities, soft allocations, available-to-promise, and valuation.

The Stock Overview screen provides immediate operational metrics:

- **Available Qty:** Derived on-hand balance minus active sales order soft allocations.
- **Reorder Point (ROP):** Configured minimum threshold triggering automated replenishment.
- **Total Inventory Value:** Real-time valuation derived dynamically from actual receipt unit costs.

5.3 The Append-Only Stock Movement Ledger

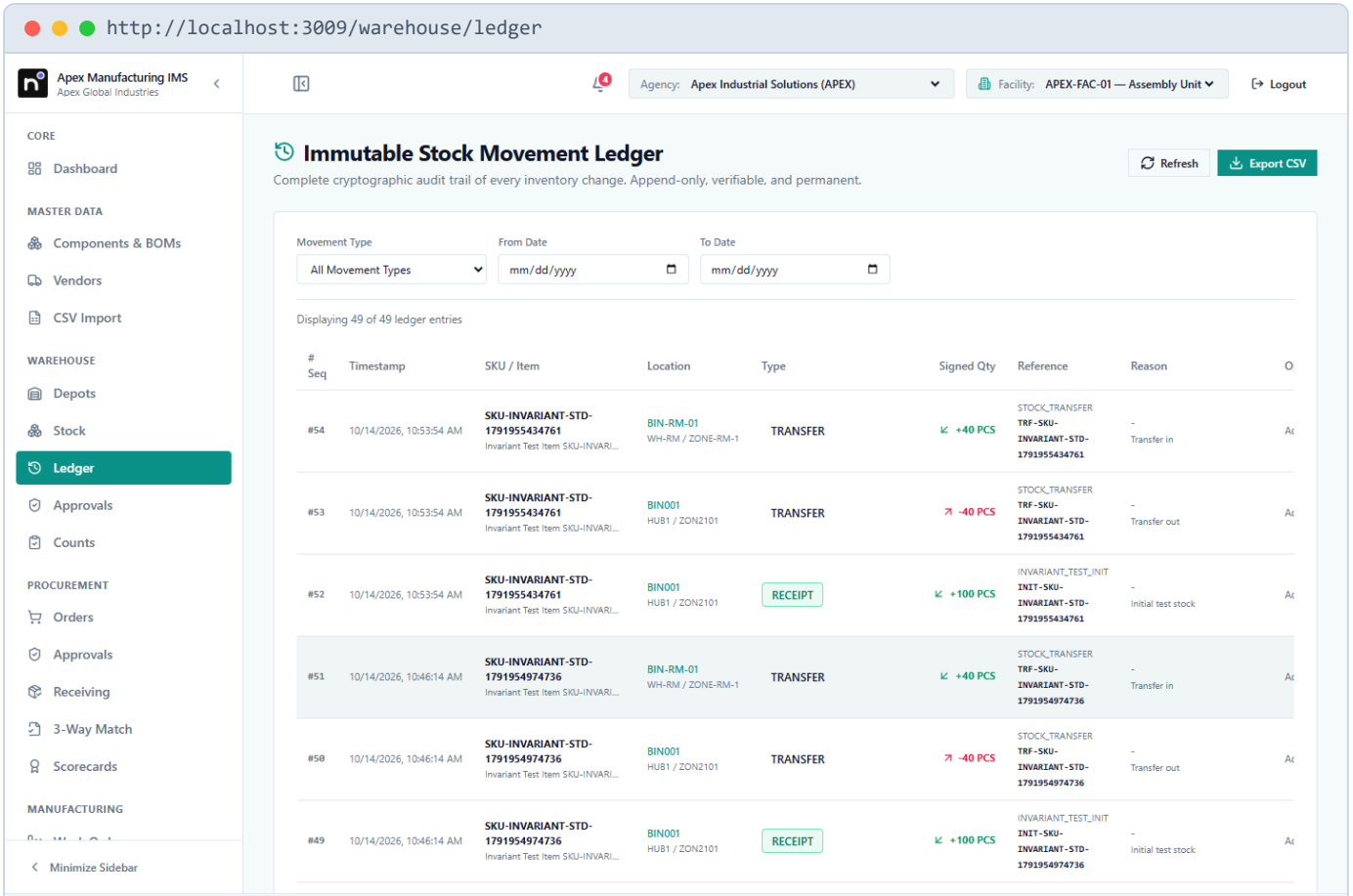


Figure 5.3: Immutable stock movement ledger recording transaction types, quantities, lots, users, and audit references.

Every physical movement generates an immutable record in `stock_movement`:

Movement Type	Quantity Sign	Triggering Business Event	Associated Reference Entity
`RECEIPT`	Positive (+)	Inbound purchase order goods receipt	PurchaseOrder / GoodsReceipt
`ISSUE`	Negative (-)	Manual consumption or floor draw	Department / Expense Code
`TRANSFER`	(-) Out / (+) In	Relocation between bins or warehouses	StockTransfer Document
`ADJUSTMENT`	(+) or (-)	Scrap write-off, damage, or found stock	StockAdjustment Approval
`PRODUCTION_CONSUME`	Negative (-)	BOM component consumption into job	WorkOrder ID
`PRODUCTION_OUTPUT`	Positive (+)	Finished goods completion posting	WorkOrder ID / Lot ID
`SALES_SHIP`	Negative (-)	Sales order pick confirmation dispatch	SalesOrder / PickList ID
`CYCLE_COUNT_CORRECTION`	(+) or (-)	Reconciliation variance posting	CycleCount Task ID

5.4 Stock Adjustments & Threshold Approval Workflow

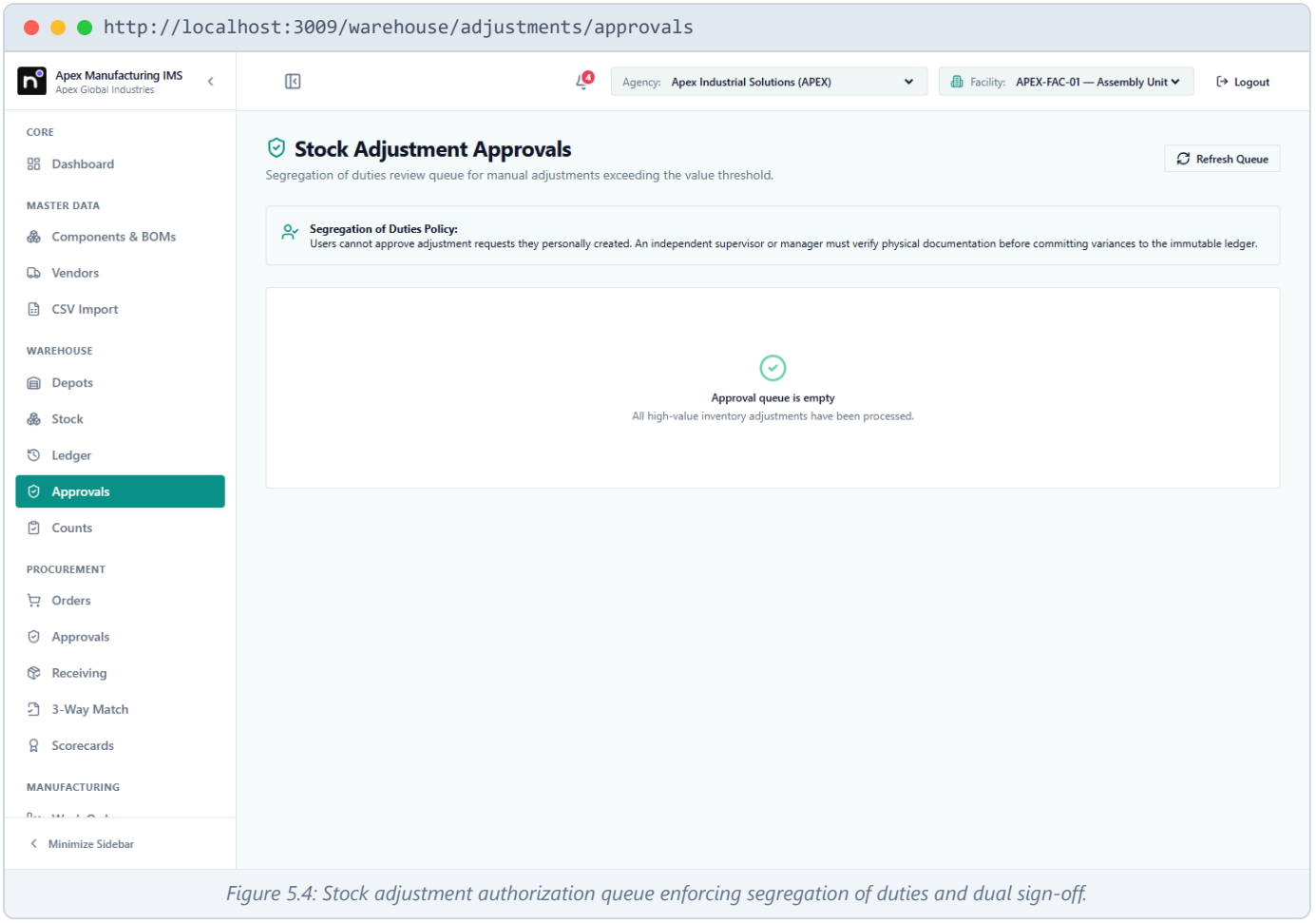


Figure 5.4: Stock adjustment authorization queue enforcing segregation of duties and dual sign-off.

Manual inventory adjustments require a controlled reason code (`DAMAGE`, `THEFT`, `COUNT_ERROR`, `EXPIRY`, `OTHER`). Any adjustment exceeding the organization's financial threshold ($500 standard) enters the **Adjustment Approvals Queue**. The adjustment will not commit to the ledger until authorized by a Warehouse Manager or Finance Auditor who is NOT the submitter.

5.5 Physical Inventory Cycle Counting & Variance Posting

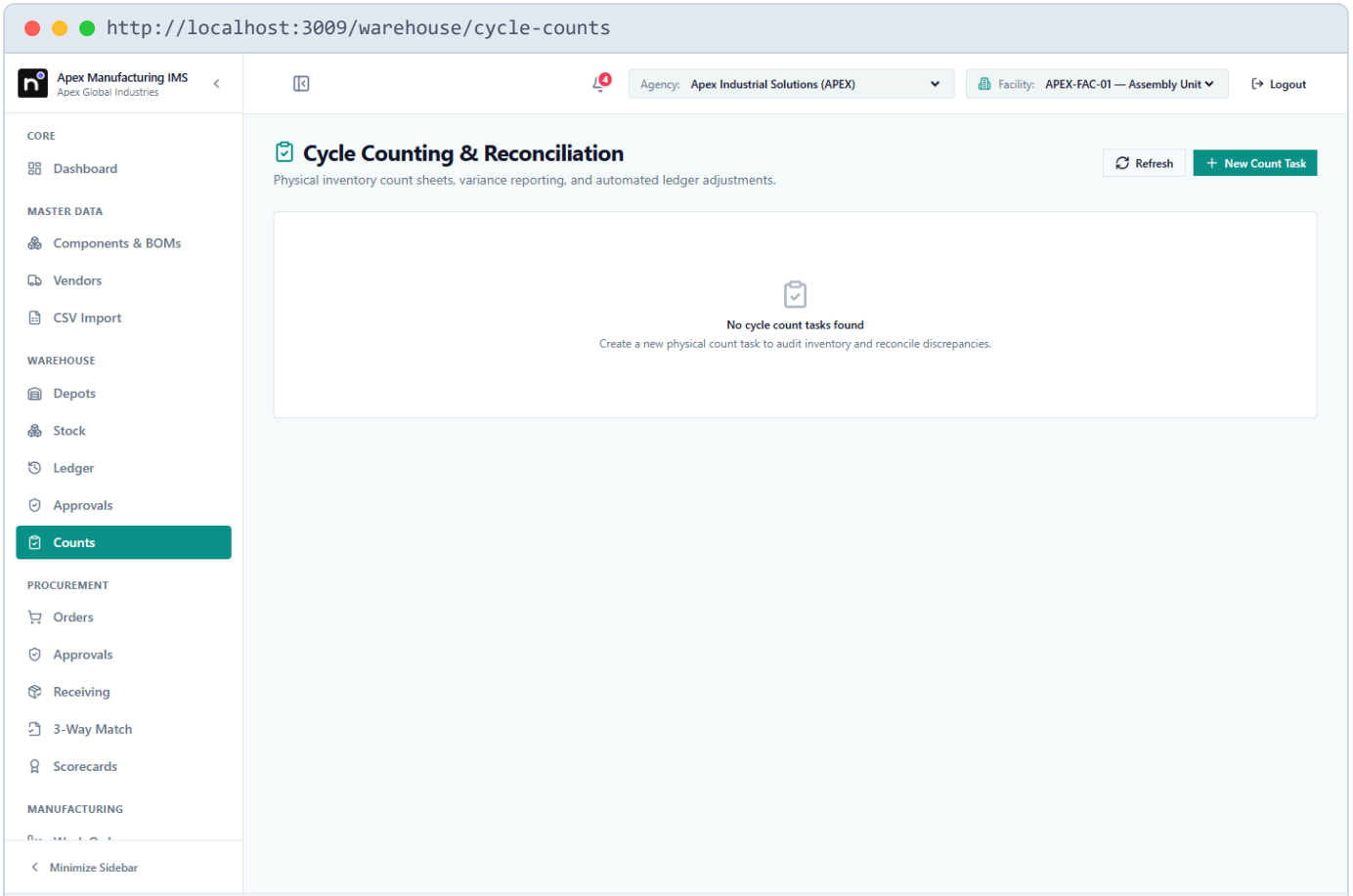


Figure 5.5: Cycle count management interface tracking count status, counted quantities, and variance reconciliations.

Cycle Count Verification Workflow:

1. **Schedule Count:** Supervisor generates a cycle count task targeting a specific warehouse zone or high-value bin.
2. **Floor Execution:** Floor staff perform blind physical counts and input recorded quantities.
3. **Variance Reconciliation:** If counted quantity differs from system derived quantity, variance % and financial delta are highlighted.
4. **Post Correction:** Manager approval auto-posts a `CYCLE_COUNT_CORRECTION` entry to the stock ledger.

6.0 Procurement & Inbound Fulfillment

The procurement module governs vendor relationship management, purchase orders, inbound goods receiving, and 3-way invoice matching.

6.1 Purchase Order Lifecycle & Line Item Costing

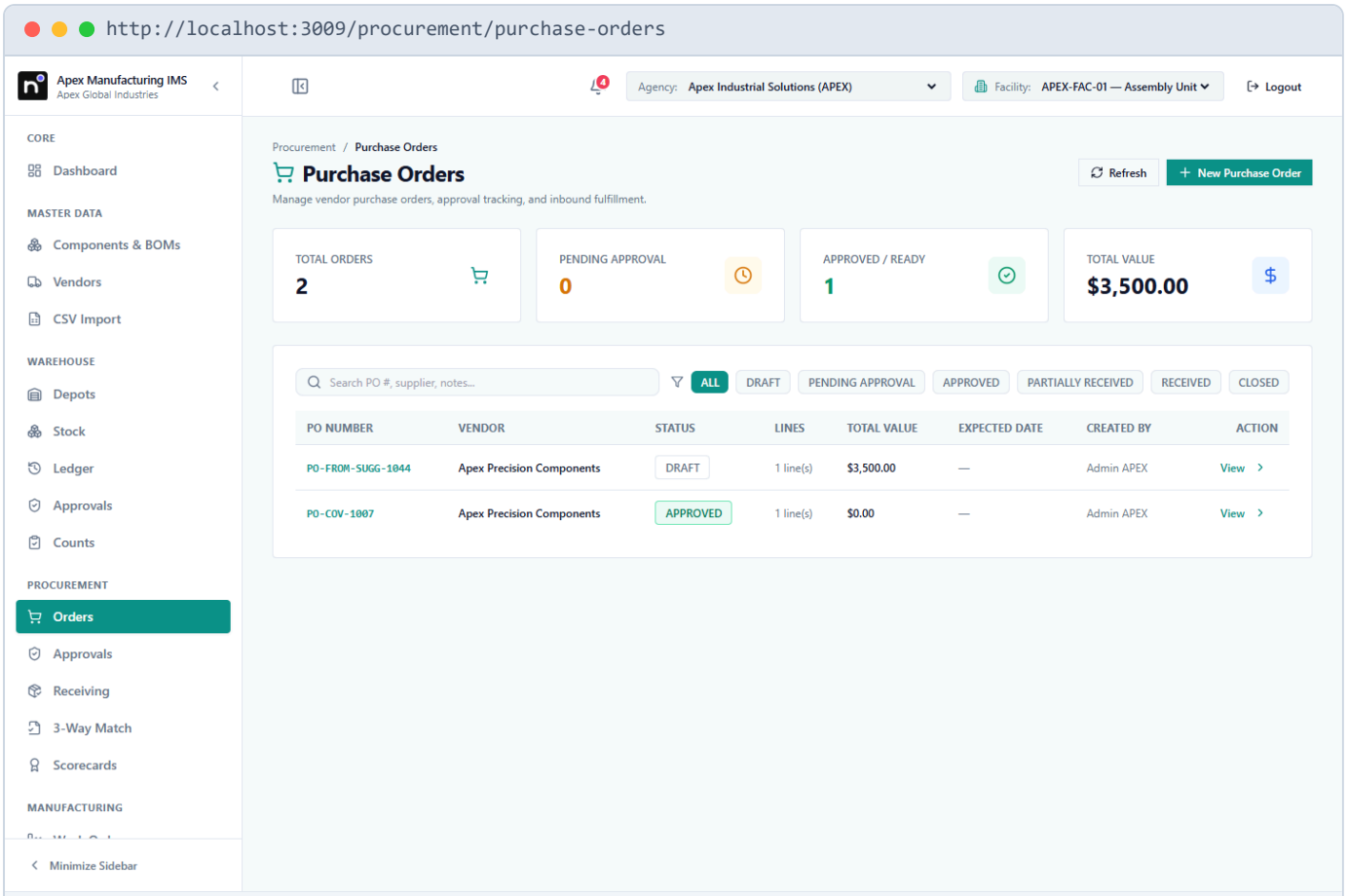


Figure 6.1: Purchase order registry showing order statuses, vendor details, total commitment values, and line items.

Purchase orders progress through structured lifecycle states: `DRAFT` → `PENDING_APPROVAL` → `APPROVED` → `PARTIALLY_RECEIVED` → `RECEIVED` → `CLOSED`.

6.2 Segregation of Duties PO Approval Queue

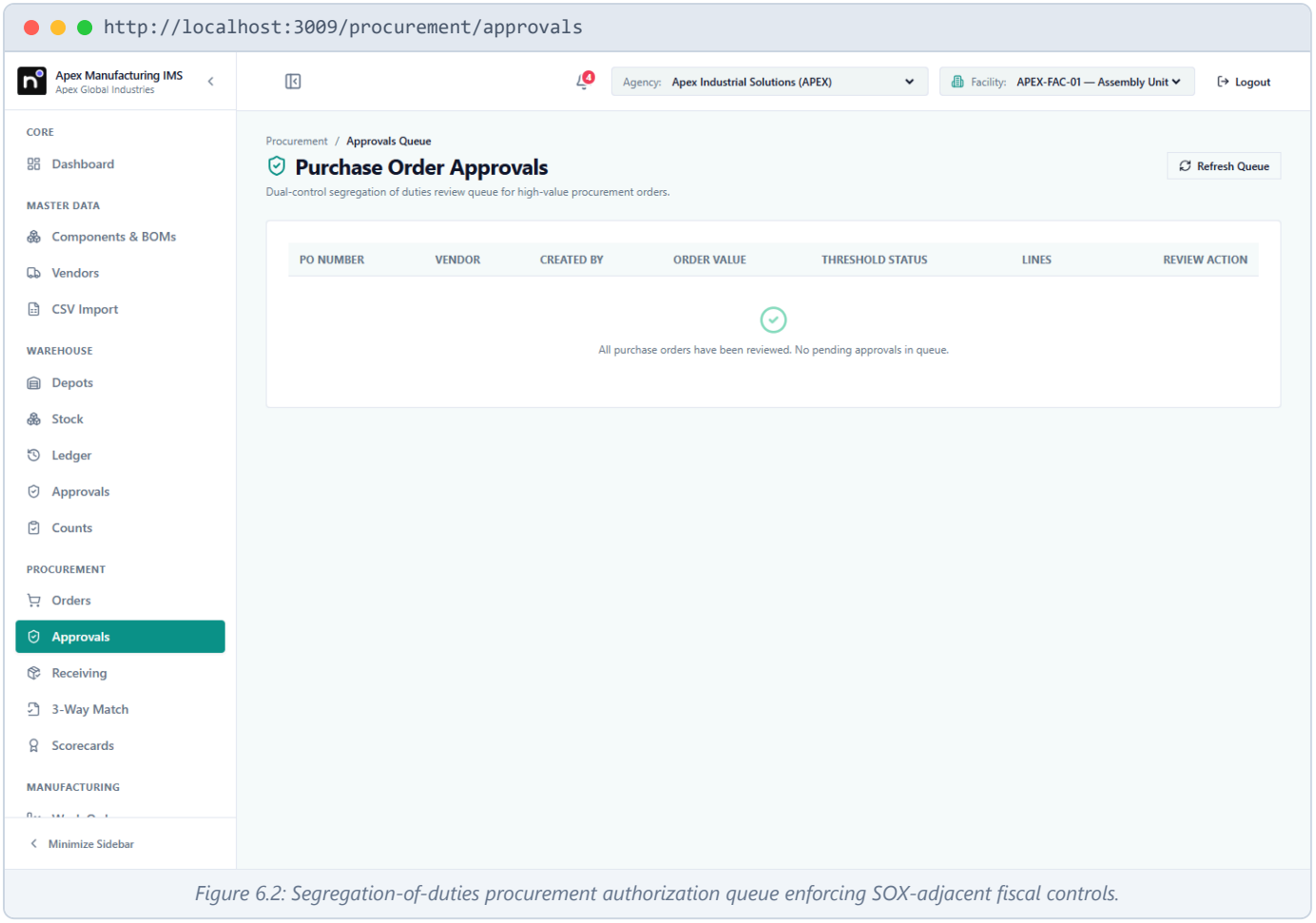


Figure 6.2: Segregation-of-duties procurement authorization queue enforcing SOX-adjacent fiscal controls.

COMPLIANCE RULE: ANTI-SELF-APPROVAL

In compliance with SOX and manufacturing financial governance, a buyer who creates a purchase order above the approval threshold ($1,000 standard) CANNOT approve their own order. Approval must be executed by an authorized Procurement Manager or Finance Director.

6.3 Goods Receiving & Receiving Bin Intake

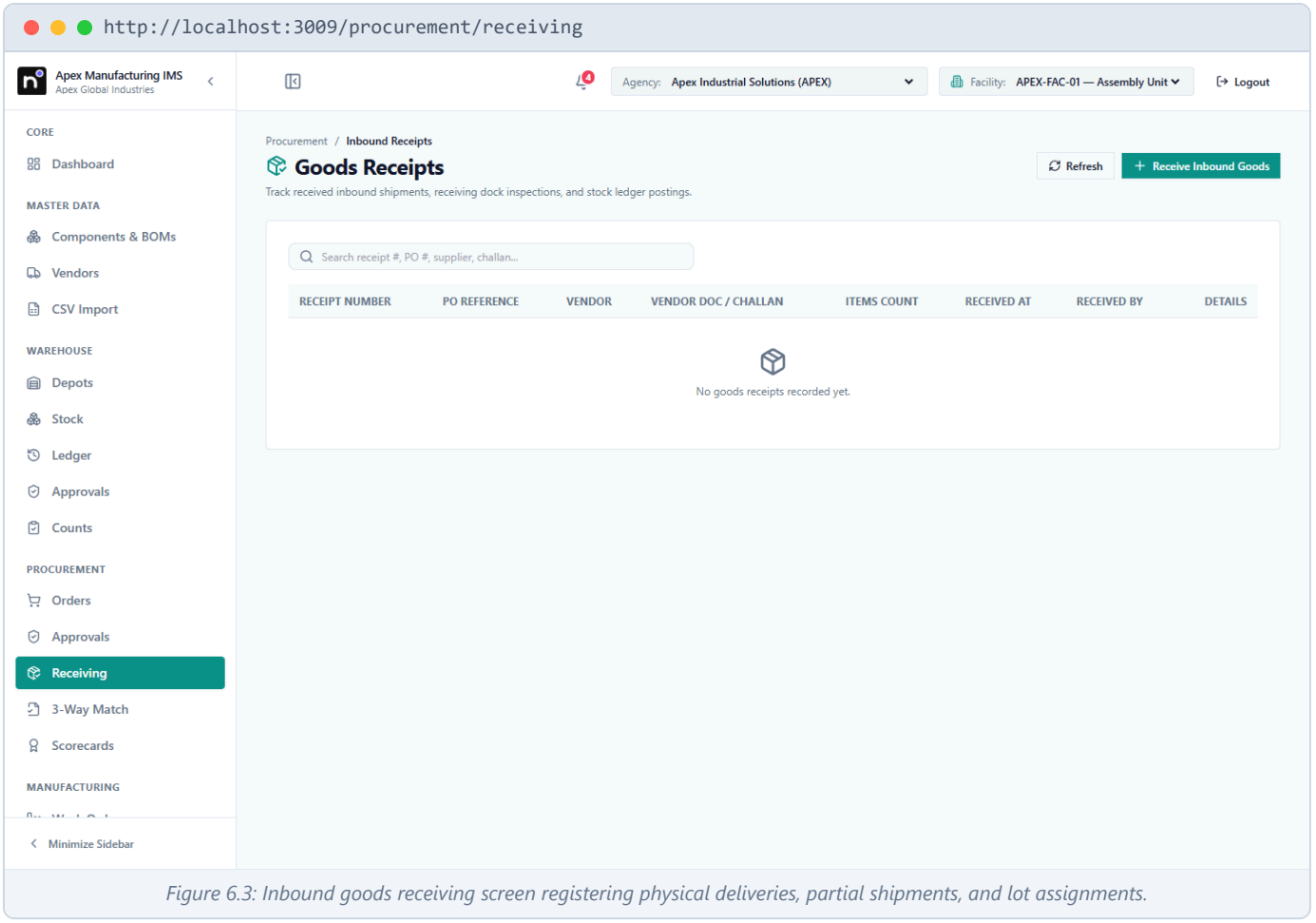


Figure 6.3: Inbound goods receiving screen registering physical deliveries, partial shipments, and lot assignments.

When freight arrives, receiving clerks record delivery notes against open PO lines. The system supports:

- **Partial Receipts:** Moves PO to `PARTIALLY_RECEIVED`; remaining balances remain open.
- **Lot Assignment:** If an item is marked `is_lot_tracked`, a lot number and expiration date are required upon intake.
- **Atomic Ledger Commits:** Goods receipt creates a `RECEIPT` stock movement entry into the receiving bin inside the same atomic database transaction updating the PO line received quantity.

6.4 Three-Way Match: PO, Receiving & Vendor Invoice

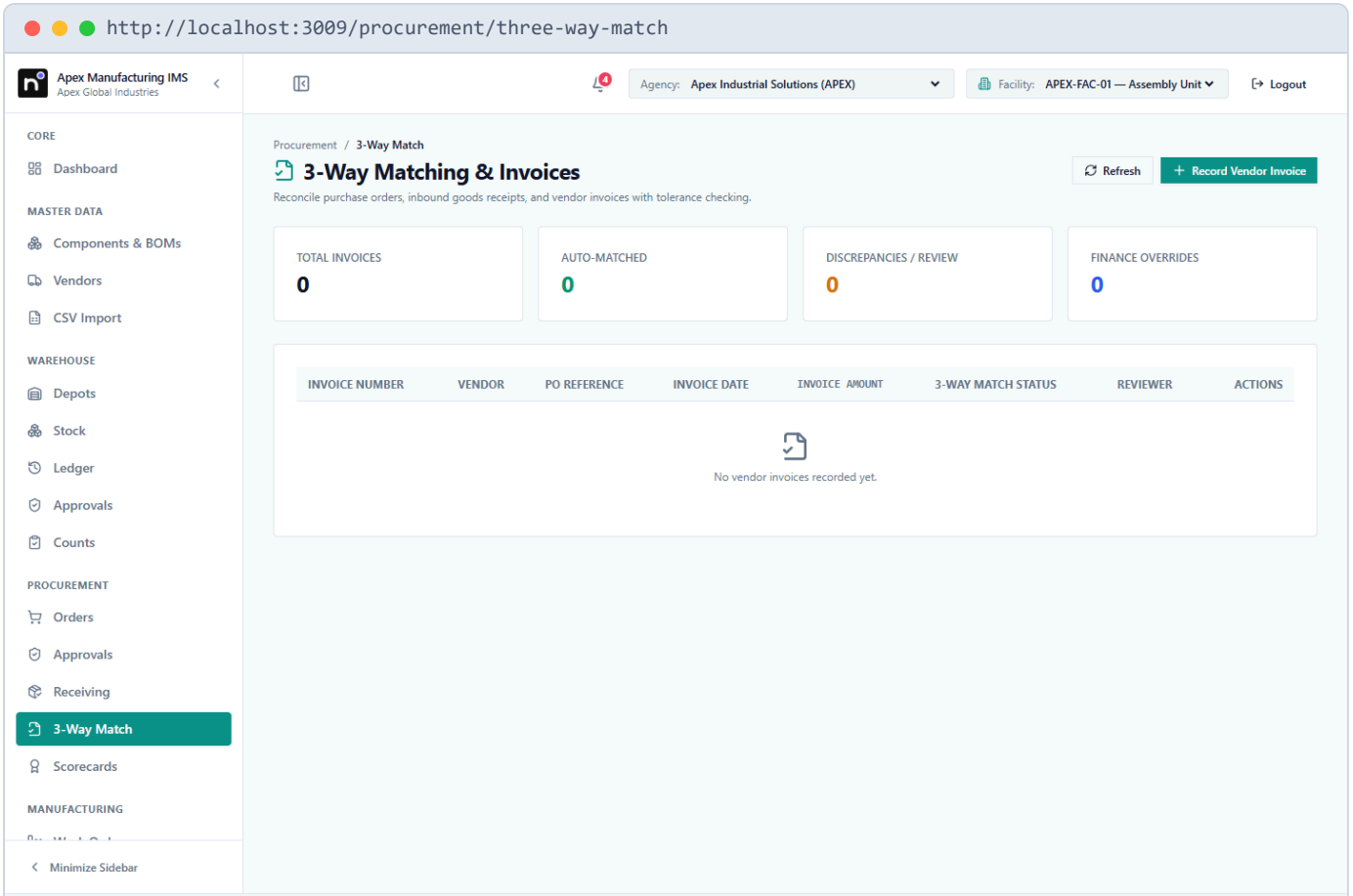


Figure 6.4: Three-way invoice matching reconciliation reconciling purchase order pricing, goods receipt quantities, and billed invoices.

Three-way matching protects against over-billing and fraudulent invoices:

1. **PO Comparison:** Checks authorized unit price and contracted quantities.
2. **Receipt Comparison:** Verifies actual physical quantities received and accepted by warehouse clerks.
3. **Vendor Invoice Comparison:** Validates vendor billed amount. Mismatches exceeding configured tolerances (e.g. ±2%) are locked for finance review before payment release.

6.5 Supplier Performance Scorecards

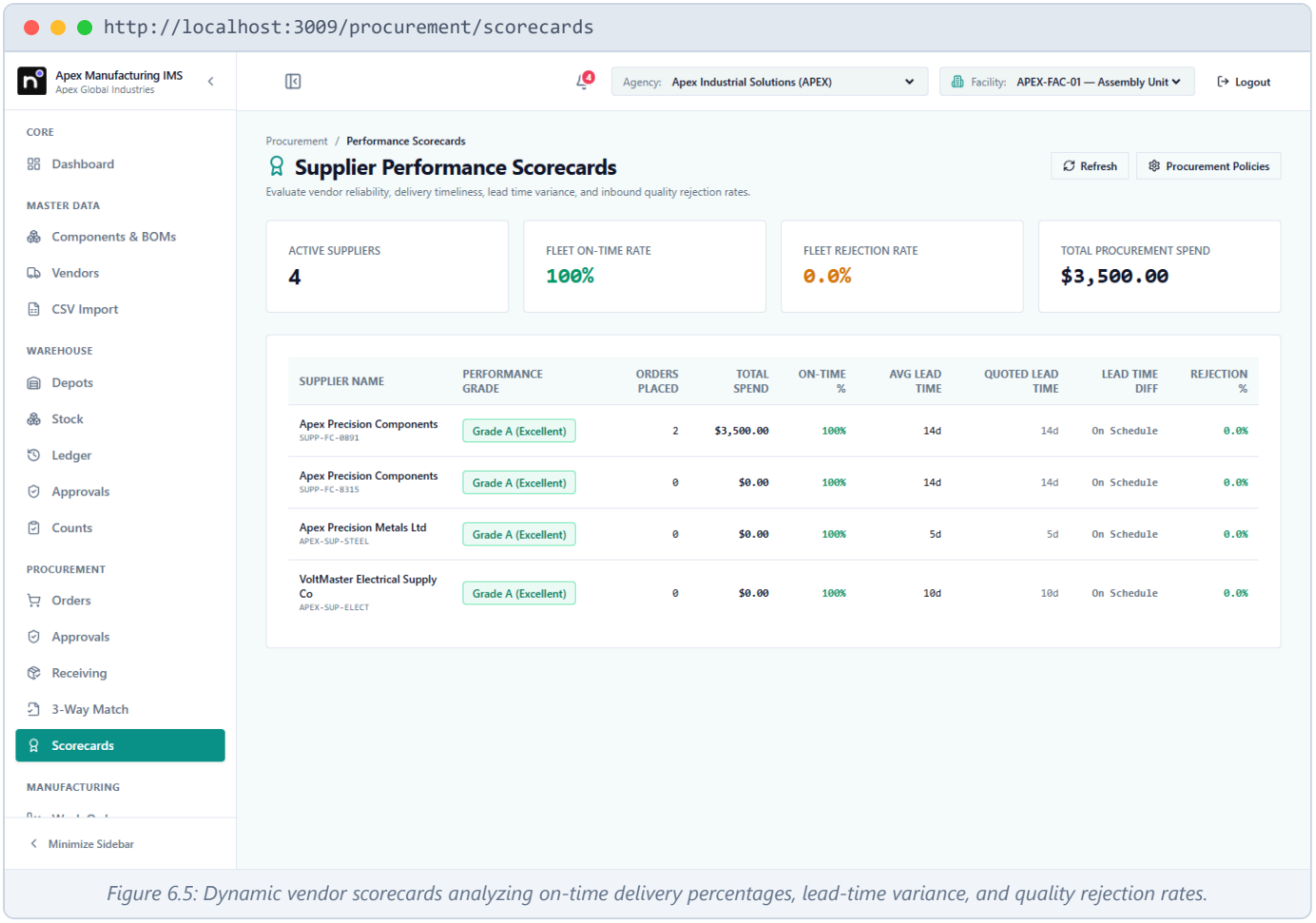


Figure 6.5: Dynamic vendor scorecards analyzing on-time delivery percentages, lead-time variance, and quality rejection rates.

7.0 Manufacturing Operations & Production Execution

The manufacturing module bridges master data specifications with shop-floor execution, tracking work orders, material consumption, and production yield.

7.1 Work Order Management & Shortage Verification

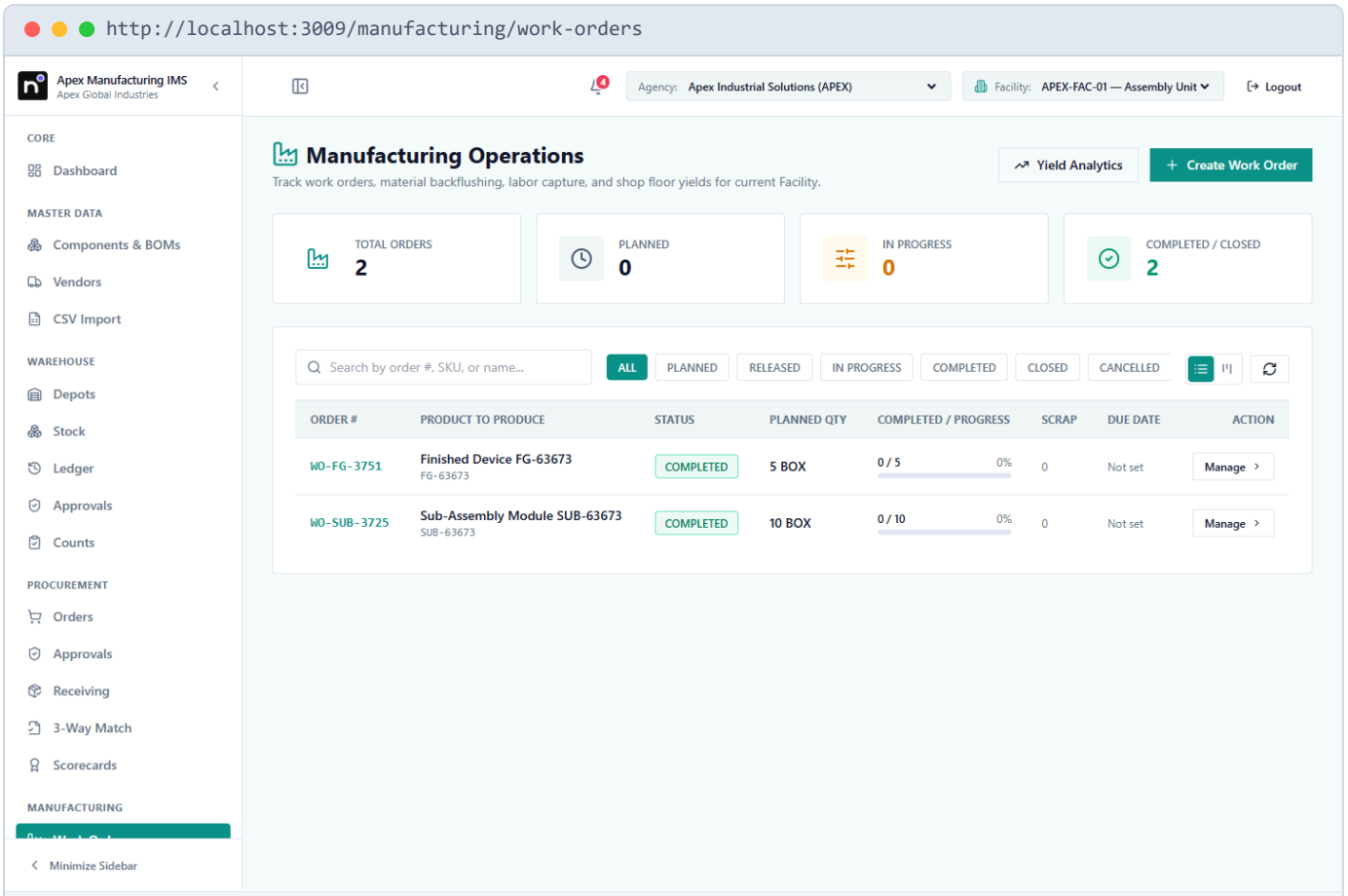


Figure 7.1: Manufacturing operations console showing planned, released, and completed work orders.

When a production planner releases a work order (status: `PLANNED` → `RELEASED`), the system executes an automated **Component Shortage Check** against real-time stock balances across all BOM lines. If components are insufficient, shortages are flagged immediately, preventing production line stoppages.

7.2 Component Consumption: Backflushing vs Manual Issue

IMS supports two distinct consumption methodologies depending on manufacturing discipline:

- **Backflushing (Continuous / Repetitive Manufacturing):** Raw materials are automatically consumed and deducted from inventory upon posting completed finished goods, calculated strictly from the BOM formula: `Consumed = Output Qty × BOM Qty Per Unit × (1 + Scrap %)`.
- **Manual Floor Issue (Custom / High-Value Assembly):** Line operators scan and record specific component lots as they are issued to the production order. Variances between planned standard BOM usage and actual usage are logged for cost accounting analysis.

7.3 Production Output Posting & Scrap Segregation

When a job completes, operators record good finished units and scrap/defect units. Good units auto-post a `PRODUCTION_OUTPUT` movement to the designated finished goods warehouse bin and assign a new manufactured lot number. Scrap units are segregated, recorded to a scrap expense account, and excluded from sellable inventory.

7.4 Shop Floor Yield Analytics & Scrap Trends

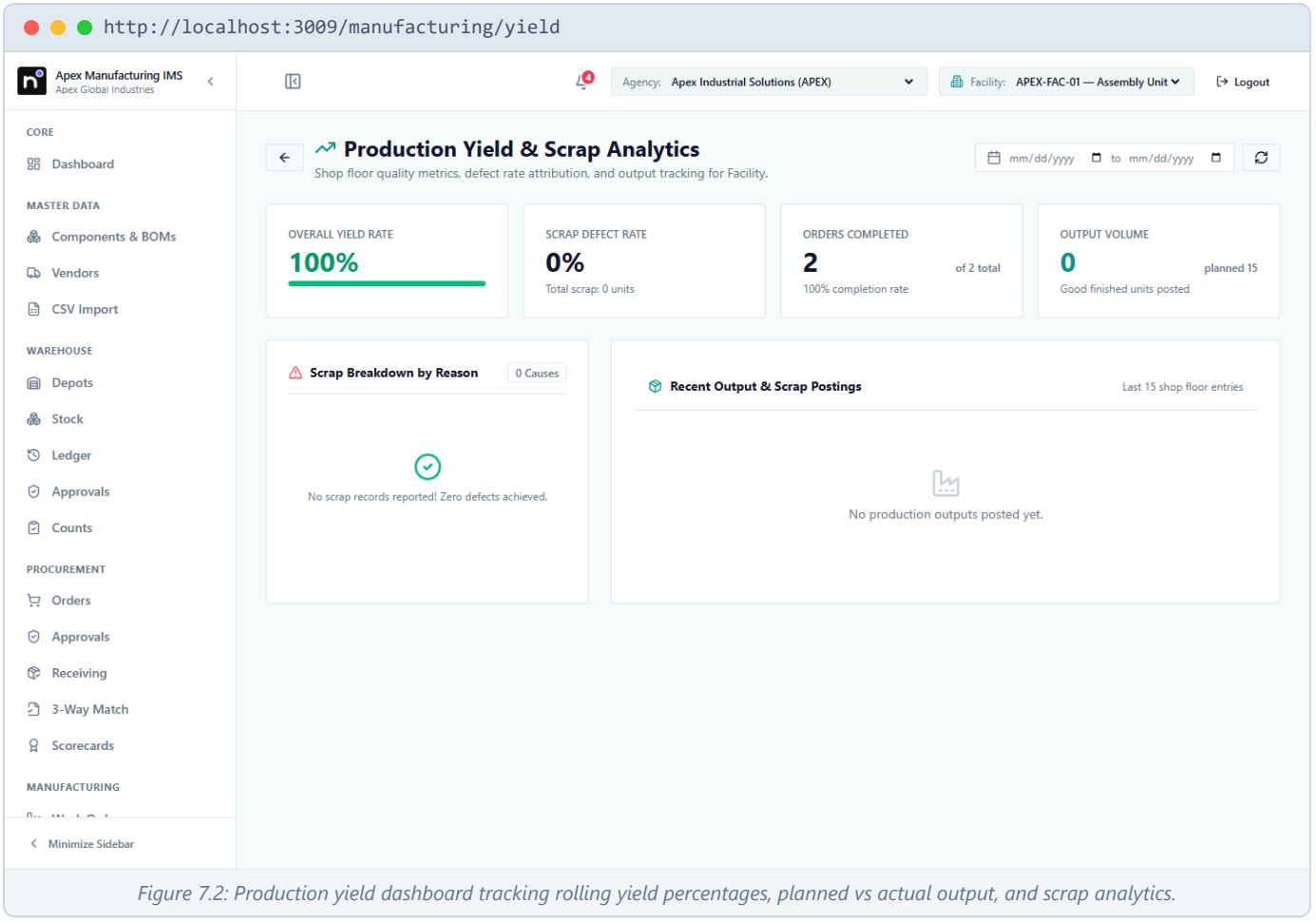


Figure 7.2: Production yield dashboard tracking rolling yield percentages, planned vs actual output, and scrap analytics.

8.0 Sales Order Processing & Fulfillment

The fulfillment engine guarantees that customer commitments align with real physical stock, preventing overselling through soft reservation algorithms.

8.1 Sales Orders & Available-to-Promise (ATP) Verification

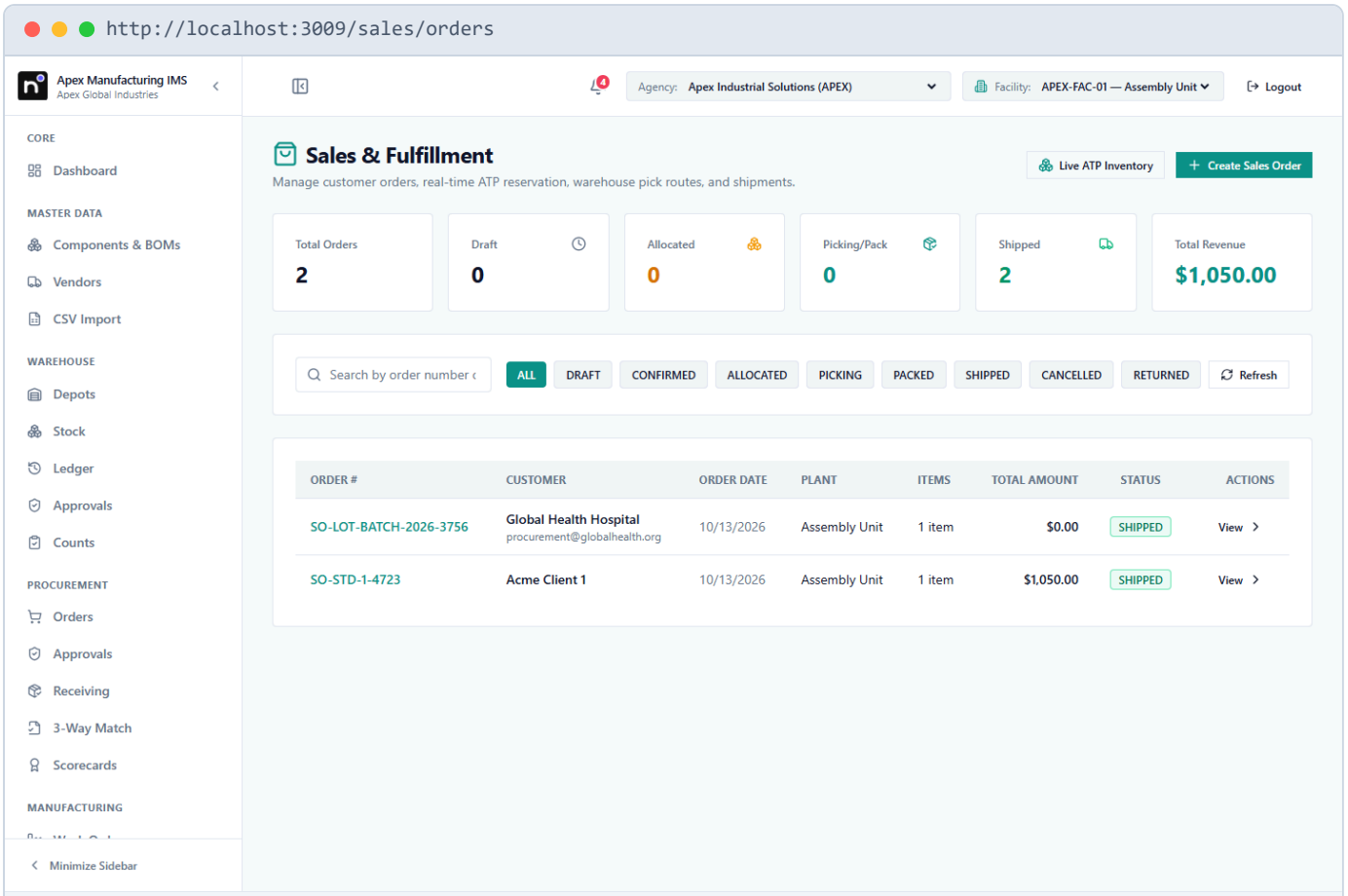


Figure 8.1: Sales order management displaying customer accounts, ATP reservation indicators, and fulfillment statuses.

Upon order entry, the **Available-to-Promise (ATP) Engine** queries current derived stock minus existing active allocations. Orders exceeding available stock are backordered or flagged before confirmation.

8.2 Soft Allocations & Walking-Route Pick Lists

Confirming an order creates a **Soft Reservation** in the `stock_allocation` table. This locks the quantity against other orders without creating premature ledger movements before physical handling.

The system generates optimized **Pick Lists** grouped by warehouse bin sequence, minimizing warehouse travel time for floor staff. Confirming a pick simultaneously generates the `SALES_SHIP` stock ledger movement and releases the allocation inside a single atomic transaction.

8.3 Packing Slips, Dispatch & RMA Return Workflows

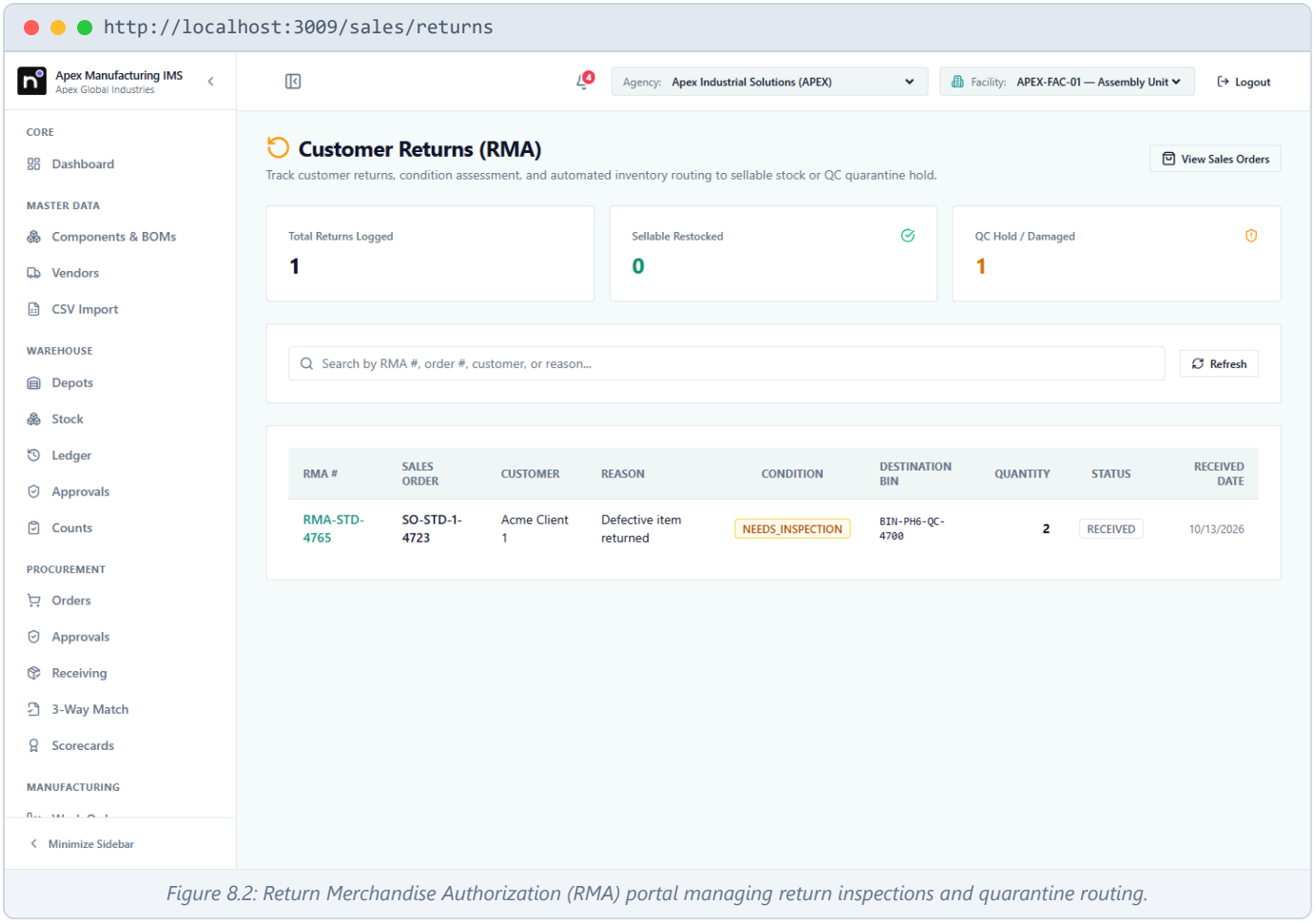


Figure 8.2: Return Merchandise Authorization (RMA) portal managing return inspections and quarantine routing.

Customer returns are processed with full provenance:

- **Sellable Stock Routing:** Pristine returned units are re-entered into sellable bins via a `RECEIPT` ledger entry referencing the original sales order.
- **Quarantine Routing:** Damaged or customer-opened goods are auto-routed to a `QC_HOLD` bin awaiting engineering inspection, preventing immediate resale.

9.0 Traceability, Quality Control & Recall Simulator

Traceability is the compliance centerpiece of IMS, providing instant forward and backward genealogy across multi-level manufacturing runs.

9.1 Lot & Batch Management with FEFO Allocation

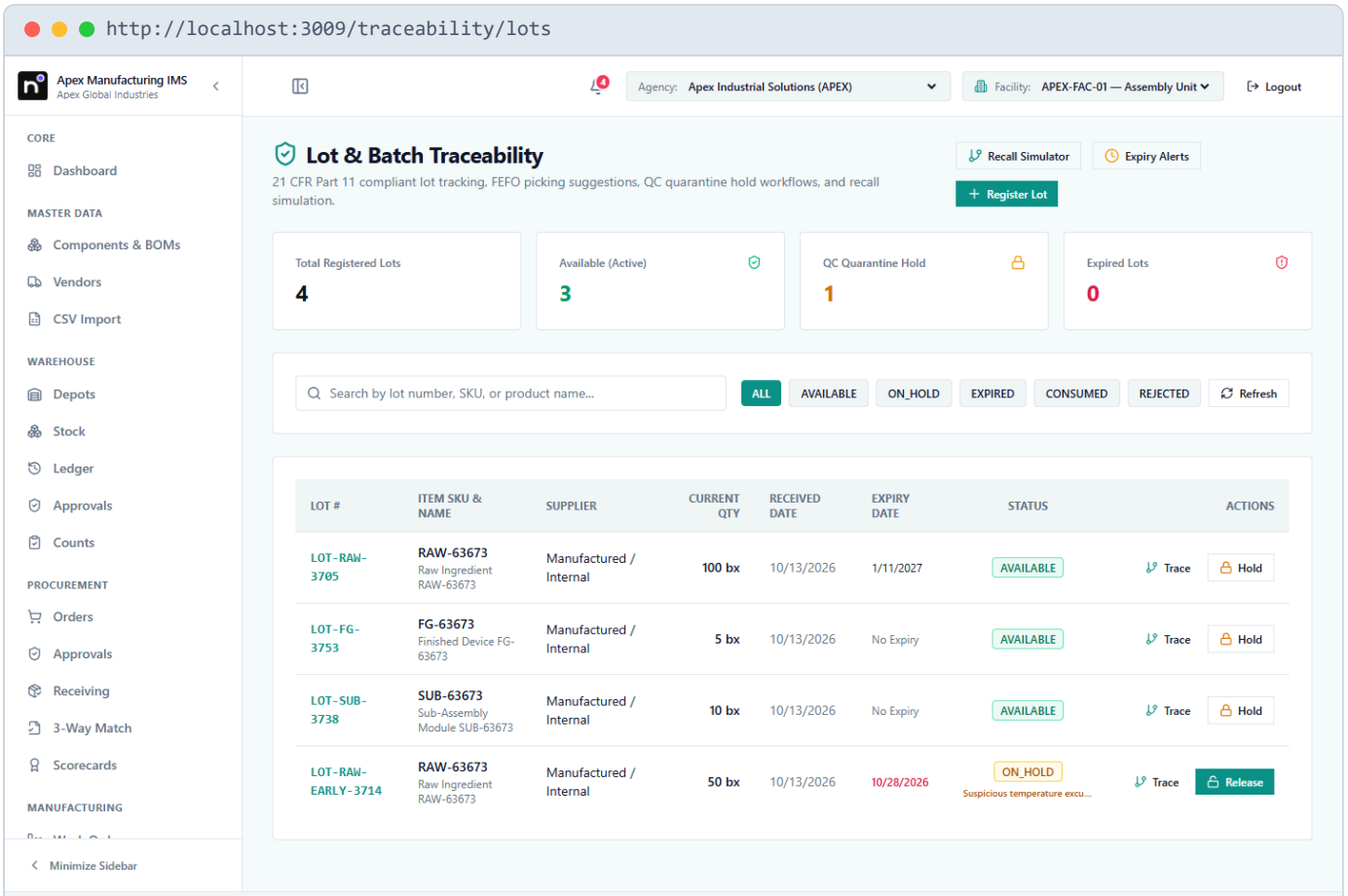


Figure 9.1: Lot and batch repository tracking lot IDs, expiration dates, supplier origins, and quarantine status.

FEFO Picking Engine: For lot-tracked materials, pick recommendations prioritize the earliest expiring lot (First-Expired, First-Out), minimizing inventory expiration waste.

9.2 QC Hold, Quarantine & Release Authorization

Quality officers can place any lot on `ON_HOLD` status with a mandatory defect code. Placing a lot on hold instantly blocks it from sales allocation, pick lists, and production consumption across the enterprise. Releasing a lot requires dual-authorization from authorized Quality personnel.

9.3 Recursive Bi-Directional Genealogy (Recall Simulator)

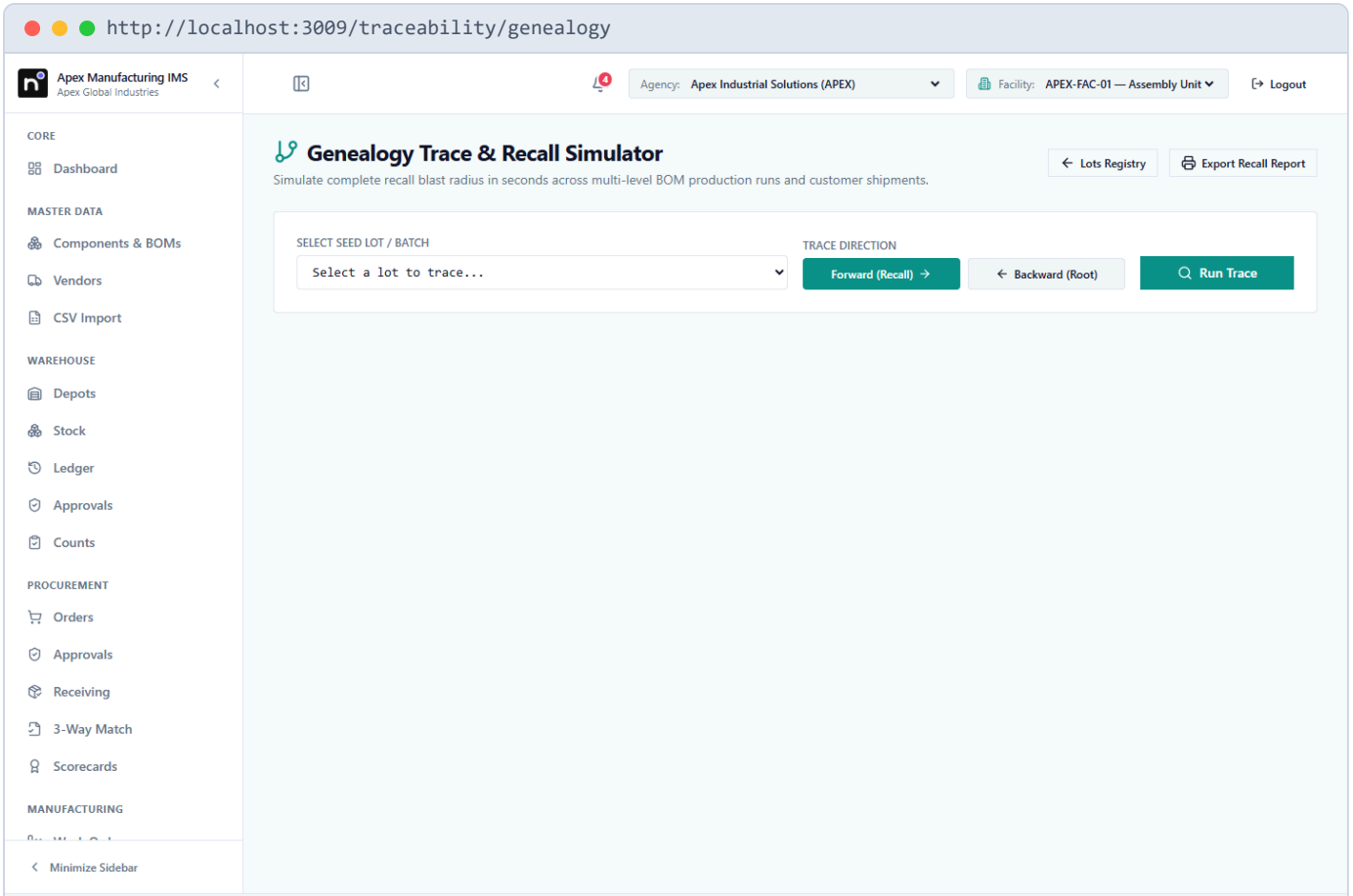


Figure 9.2: Genealogy trace interface providing instant recall blast-radius simulations in both directions.

Two-Way Recall Simulation Capabilities:

- → **Forward Trace (Raw Material Recall):** Given a tainted raw material vendor lot, the system executes a recursive PostgreSQL CTE that identifies all intermediate sub-assemblies produced, all finished goods batches, and every customer sales order shipped with contact details.
- ← **Backward Trace (Root Cause Investigation):** Given a customer defect complaint, the backward trace reconstructs the complete upstream tree, identifying all consumed raw material lots, work orders, machine operators, and original vendor purchase orders.

9.4 Expiry Alerts & Individual Unit Serials

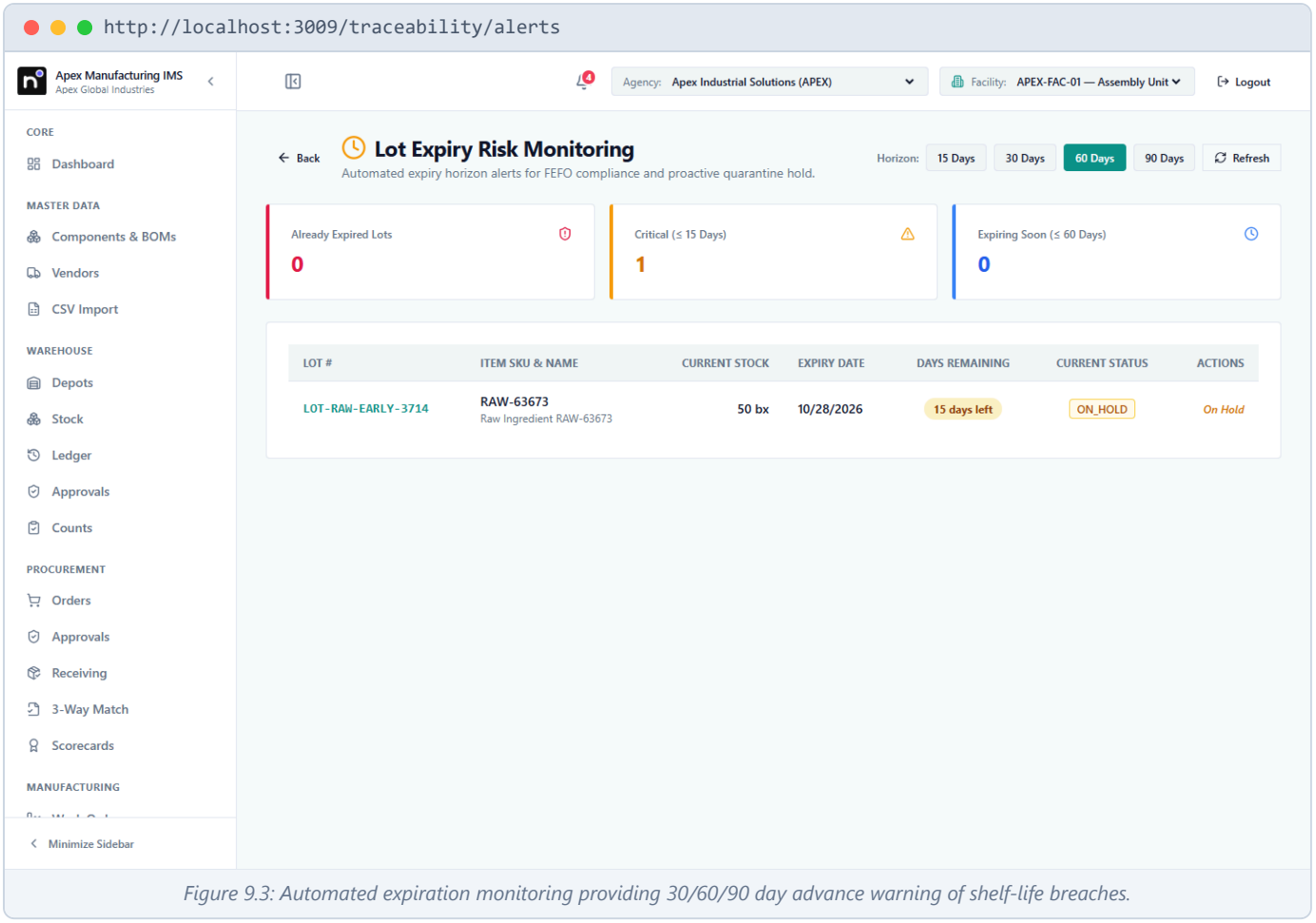


Figure 9.3: Automated expiration monitoring providing 30/60/90 day advance warning of shelf-life breaches.

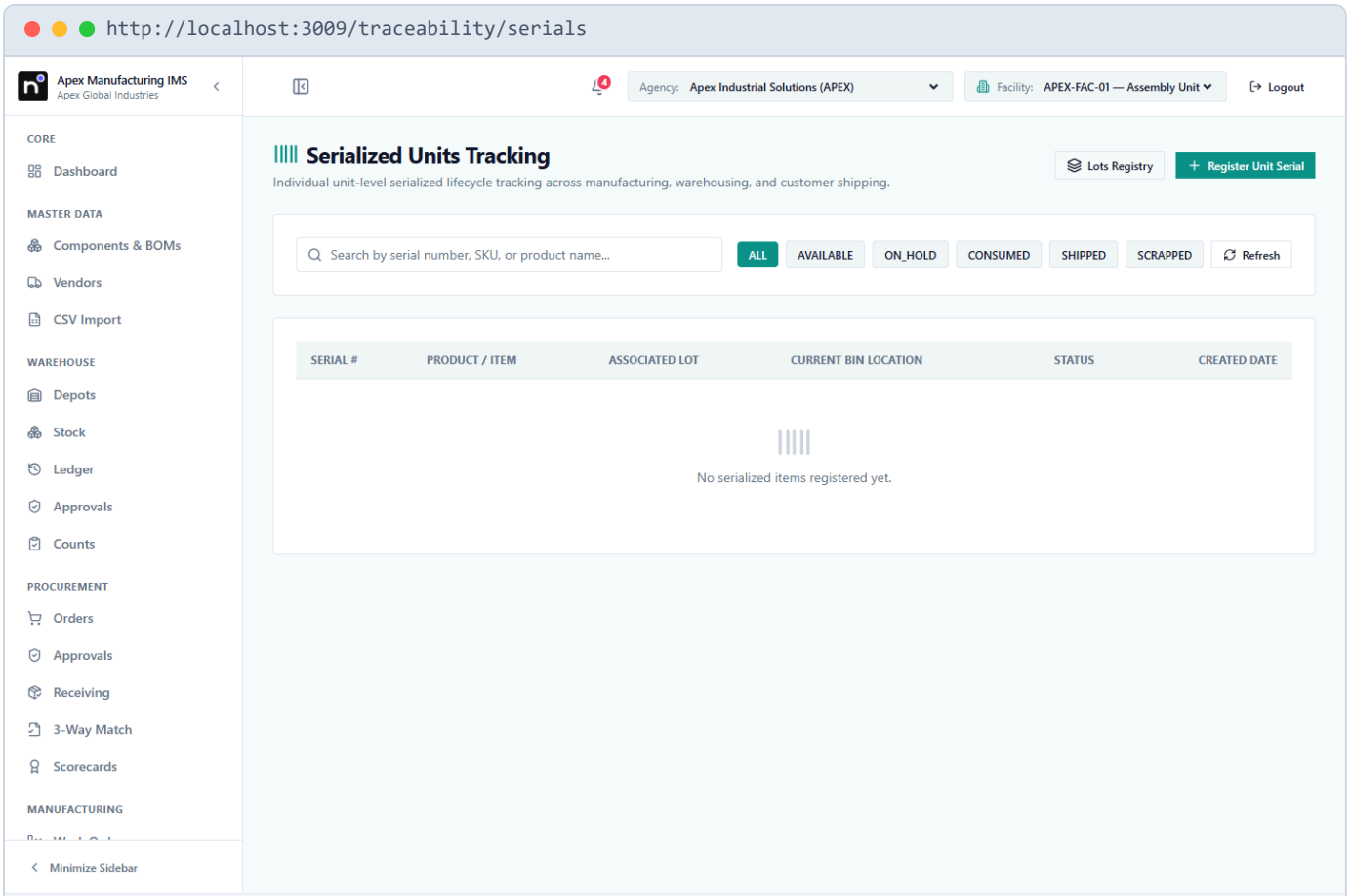


Figure 9.4: Unit serial registry tracking unique serialized equipment from manufacturing through field deployment.

10.0 Demand Forecasting & Automated Replenishment

The forecasting module transforms inventory from reactive purchasing to algorithmic, predictive replenishment based on historical consumption patterns.

10.1 Historical Demand Aggregation & Forecast Models (SMA/SES)

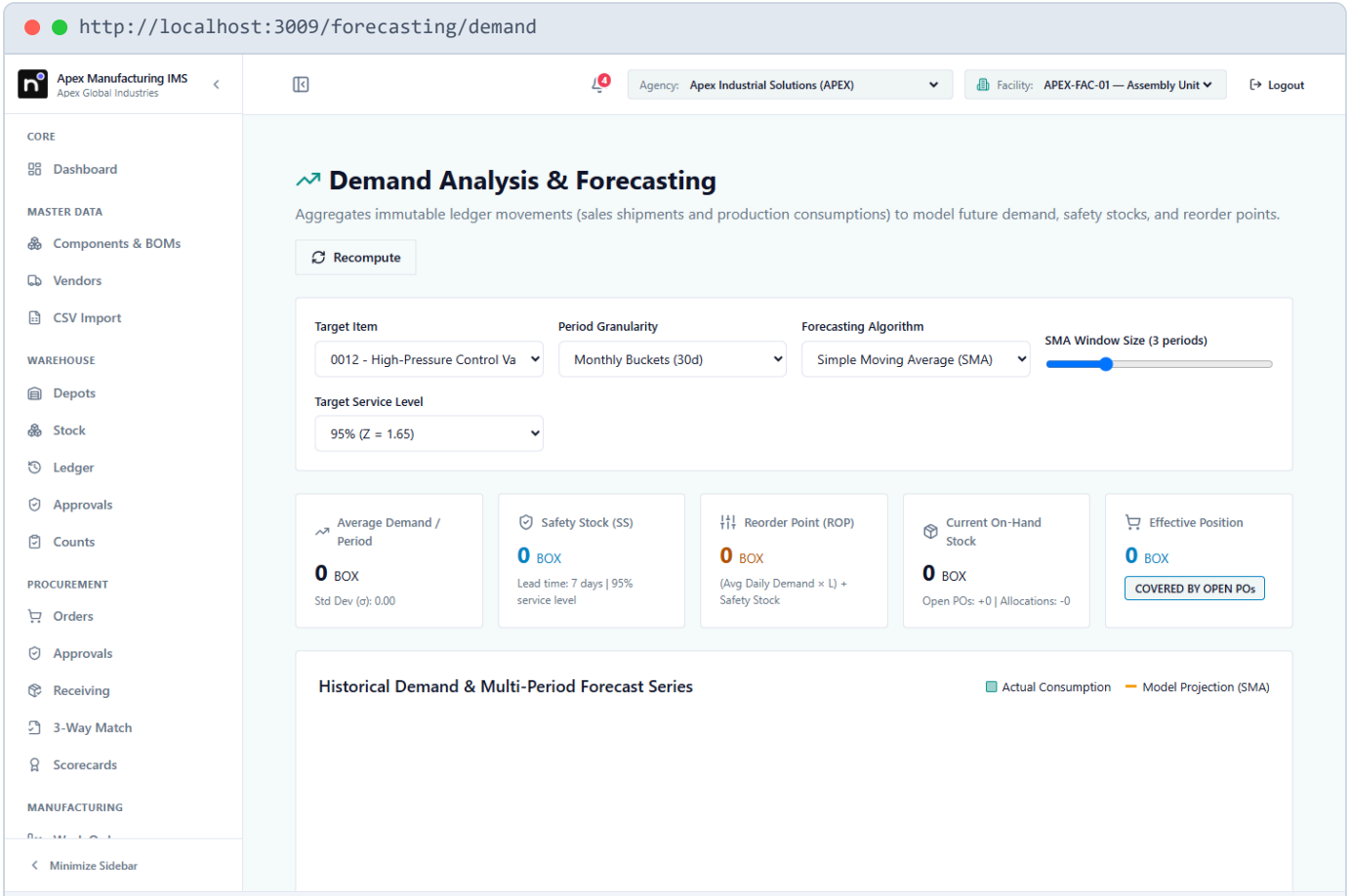


Figure 10.1: Demand analysis console comparing actual consumption curves with SMA and SES algorithmic projections.

Demand history aggregates physical `SALES_SHIP` and `PRODUCTION_CONSUME` movements from the stock ledger into weekly or monthly periods. Supported forecasting algorithms:

- **Simple Moving Average (SMA):** Averages consumption over a configurable rolling period window (e.g. 3 to 12 months) to dampen transient spikes.
- **Single Exponential Smoothing (SES):** Applies weighted exponential decay governed by smoothing parameter α (0.1 to 0.9), prioritizing recent demand fluctuations while retaining baseline history.

10.2 Safety Stock, Reorder Point (ROP) & Reorder Queue

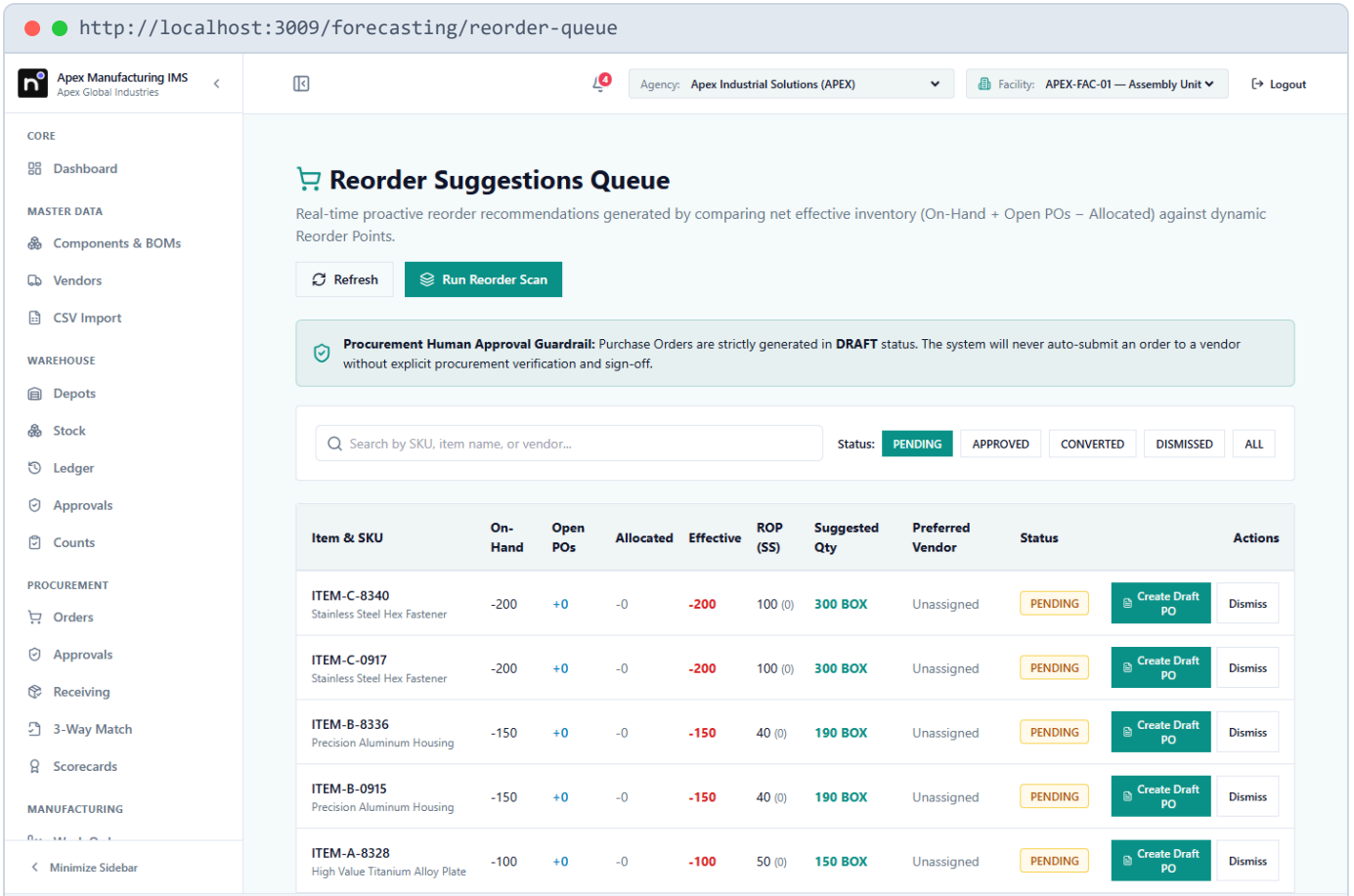


Figure 10.2: Automated reorder queue evaluating safety stocks, open PO commitments, and 1-click PO conversion.

Safety stock and ROP are calculated mathematically: `Safety Stock = Z × σ × √L` and `ROP = (Average Daily Demand × Lead Time) + Safety Stock`, where *Z* represents target service level (e.g. 95% = 1.65).

A daily scheduled job evaluates: `Effective Stock = (On-Hand + Open POs) - Allocated Orders`. When Effective Stock breaches ROP, the item enters the **Reorder Queue**. Buyers can convert suggestions into draft Purchase Orders with a single click.

10.3 Pareto ABC Consumption Value Analysis

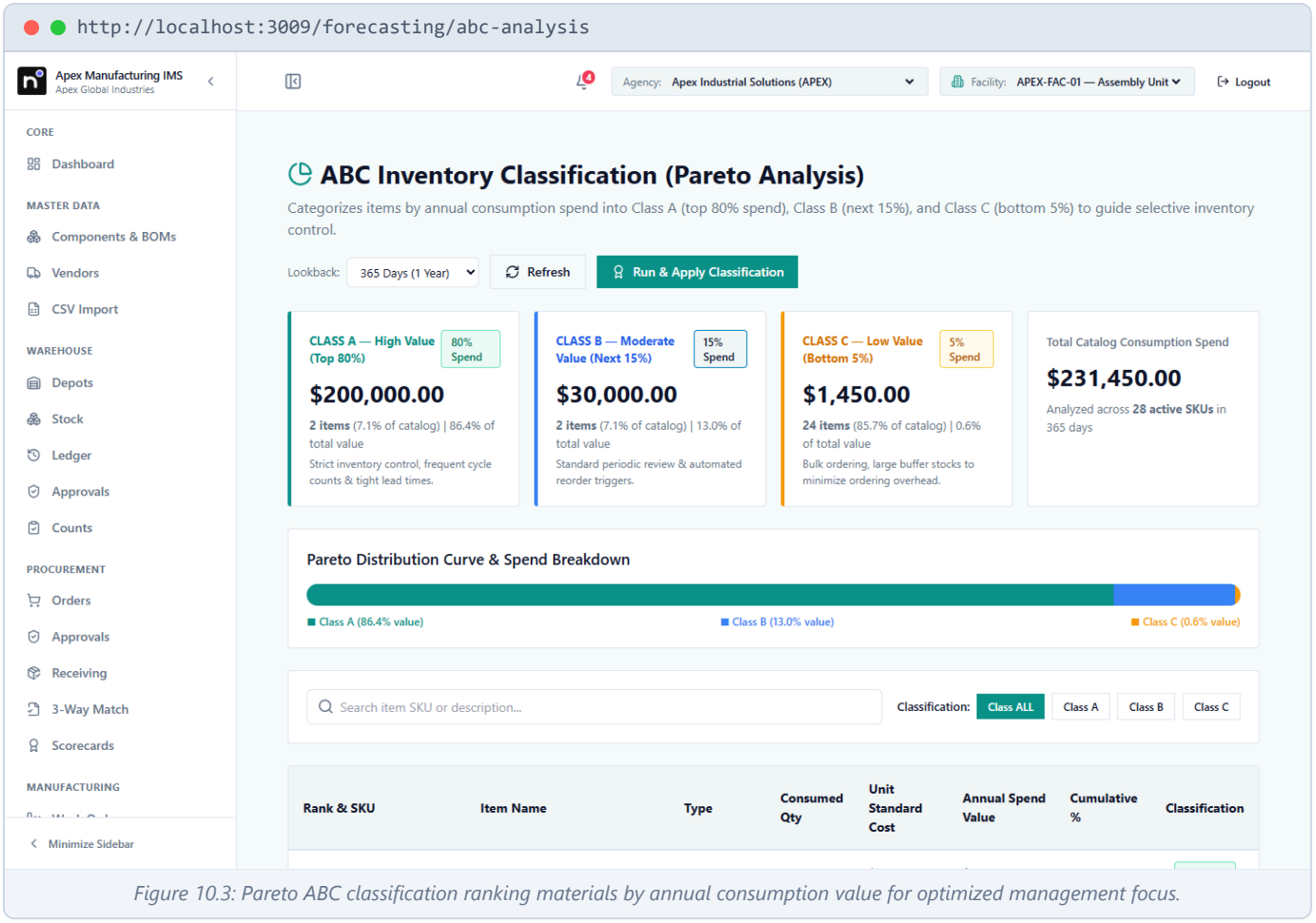


Figure 10.3: Pareto ABC classification ranking materials by annual consumption value for optimized management focus.

- **Class A (Top 80% Value):** High-value components (~15% of SKUs). Subject to strict cycle counts, tight reorder thresholds, and active management.
- **Class B (Next 15% Value):** Intermediate items (~30% of SKUs). Standard automated reorder points and bi-annual counts.
- **Class C (Remaining 5% Value):** Low-cost bulk hardware (~55% of SKUs). Managed via visual two-bin Kanban systems with bulk safety stocks.

11.0 Financial Reports & Operational Analytics

The reports hub delivers read-only executive intelligence, compliance audit documentation, inventory valuation, and automated exports.

11.1 Inventory Valuation: FIFO, LIFO & Weighted Average Cost

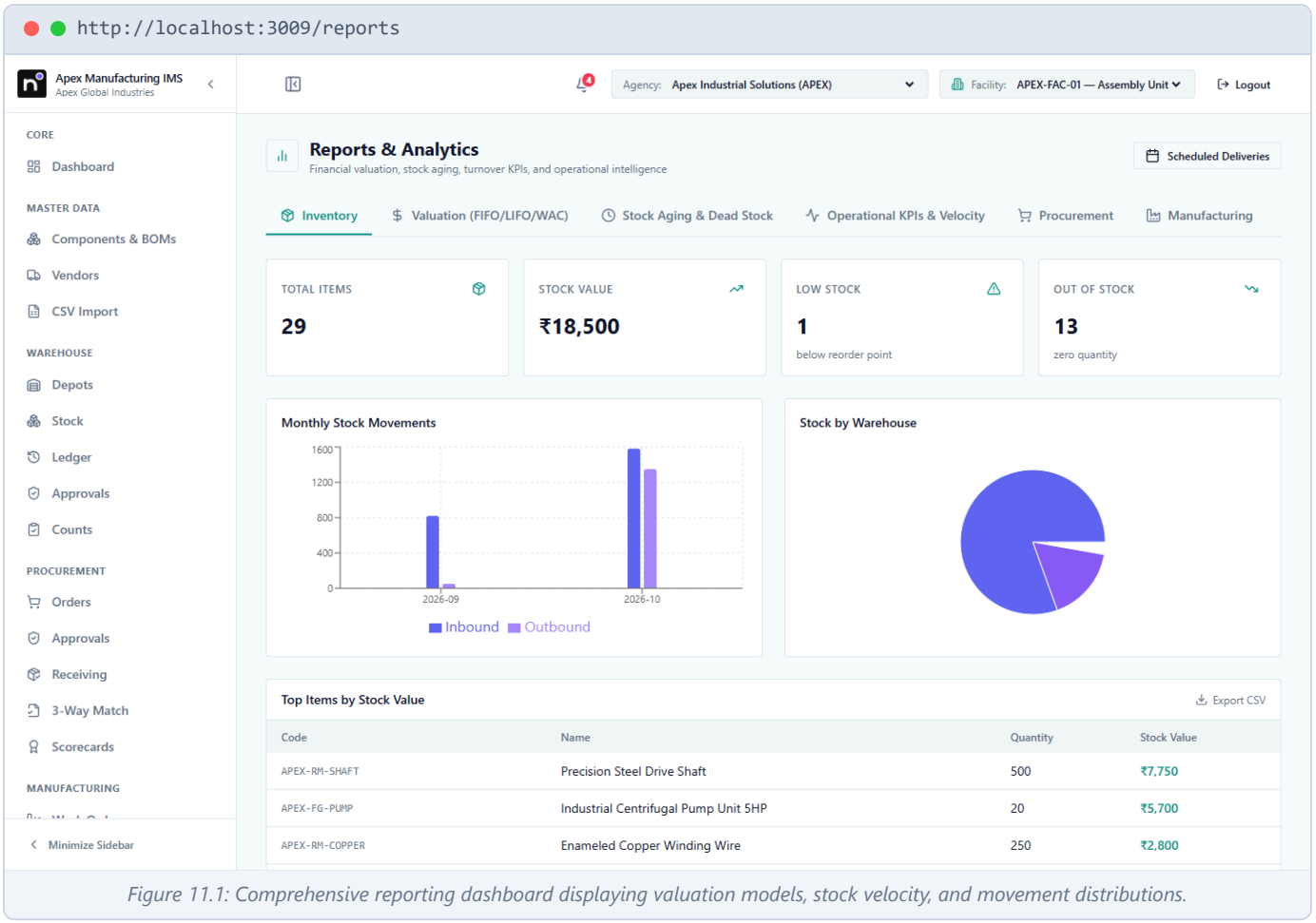


Figure 11.1: Comprehensive reporting dashboard displaying valuation models, stock velocity, and movement distributions.

Unlike systems relying on static standard costs, IMS calculates inventory balance sheets dynamically from actual receipt costs recorded in the ledger:

- **FIFO (First-In, First-Out):** Values closing inventory based on the most recently purchased lots. Compliant with IFRS and GAAP.
- **LIFO (Last-In, First-Out):** Matches current sales against most recent receipt costs. Supported for US GAAP reporting entities.
- **Weighted Average Cost (WAC):** Recomputes unit cost on every inbound receipt: `Total Value ÷ Total Quantity`.

11.2 Stock Aging & Dead Stock Identification

The Aging Report categorizes inventory by days elapsed since last ledger movement: **0–30 days**, **31–60 days**, **61–90 days**, and **>90 days (Dead Stock)**. Identifies carrying-cost liabilities and informs scrap write-off decisions.

11.3 Operational KPIs, Excel/PDF Exports & Recurring Schedules

The KPI tab computes critical operational health indicators:

- **Inventory Turnover Ratio:** Cost of Goods Sold ÷ Average Inventory.
- **Order Fill Rate:** Percentage of sales order lines fulfilled completely on first delivery.
- **Scheduled Delivery Service:** Any report can be scheduled via background cron (e.g. every Monday at 07:00 AM) to automatically generate and email encrypted PDF or Excel exports to plant executives.

12.0 System Administration, Theme Studio & Training

Enterprise control tools enable administrators to manage user access, enforce security boundaries, customize tenant branding, and monitor self-training adoption.

12.1 User Management, Facility Access & RBAC Scoping

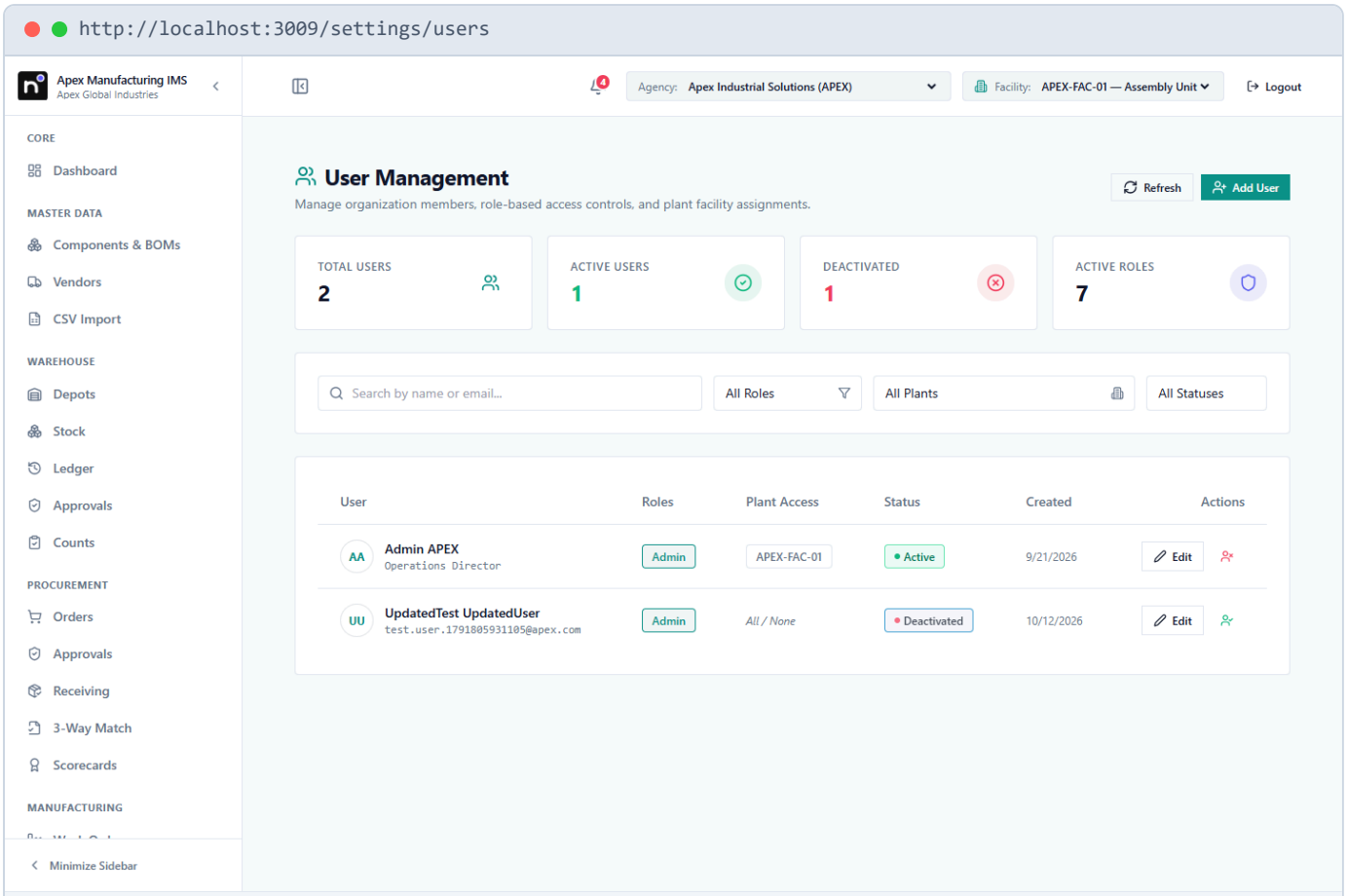


Figure 12.1: User administration console for provisioning accounts, assigning RBAC roles, and scoping plant access.

Administrators invite new employees, assign one or more standard roles, and grant explicit **Facility Scoping Permissions**. A user assigned only to Facility 1 cannot query or execute transactions against Facility 2, strictly enforced server-side.

12.2 Theme Studio: Live Branding & Terminology Customization

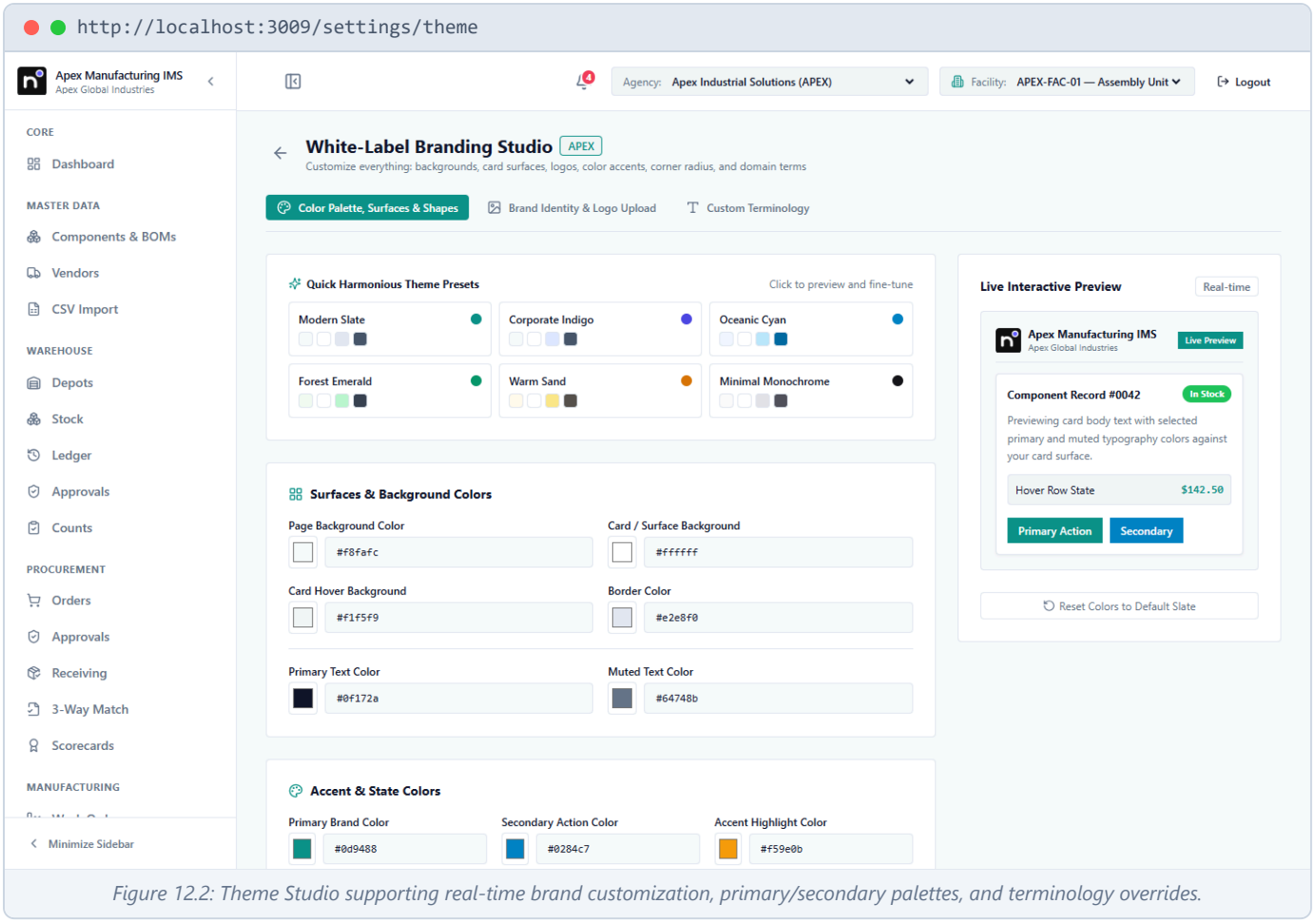


Figure 12.2: Theme Studio supporting real-time brand customization, primary/secondary palettes, and terminology overrides.

12.3 In-App Interactive Training Administration & Analytics

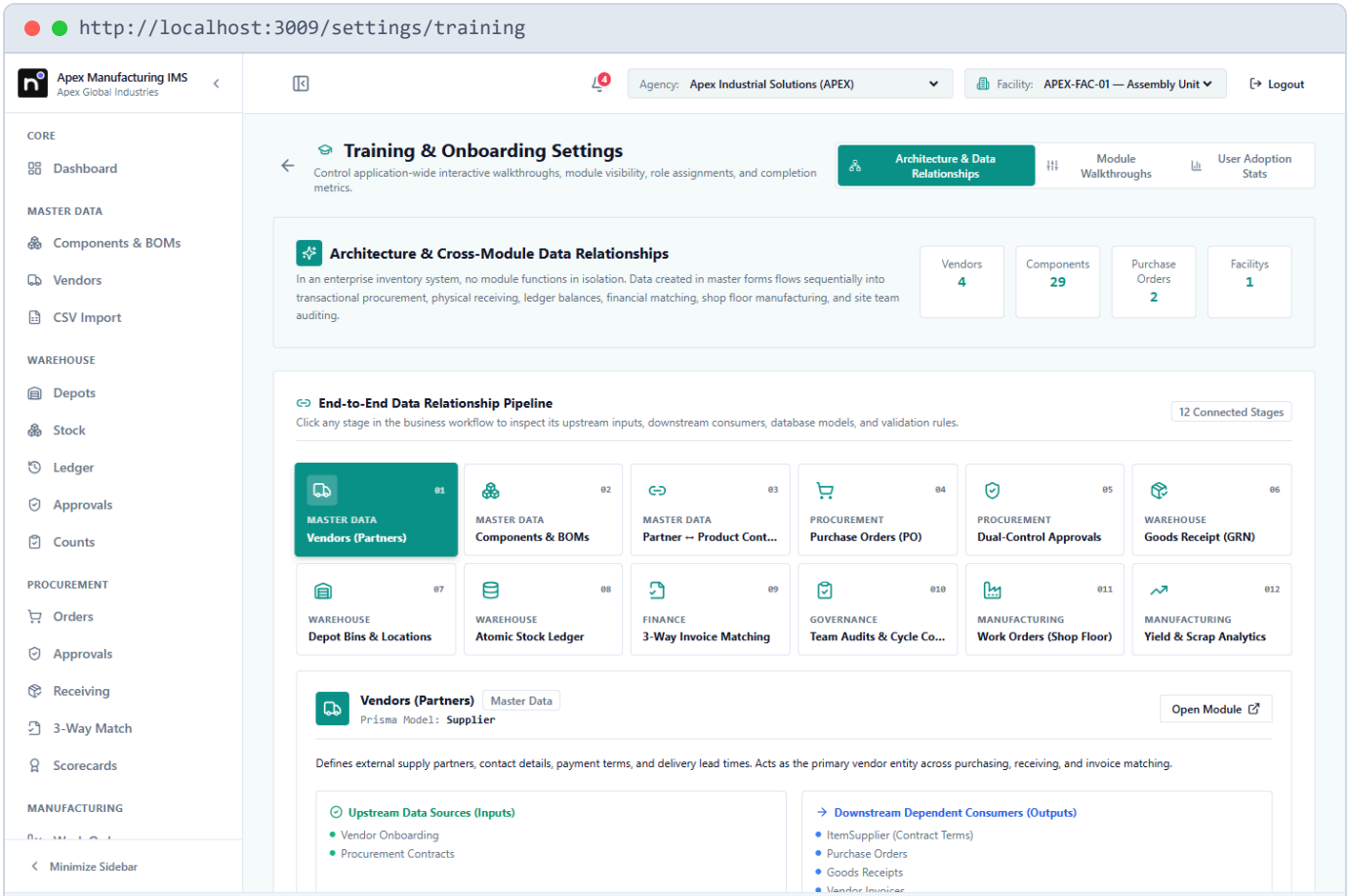


Figure 12.3: Training administration console with global tour toggles, auto-prompt rules, and module completion analytics.

Because IMS is delivered as a fully self-trainable SaaS product without requiring on-site trainers, the built-in **In-App Training Engine** provides:

- **Auto-Prompt on First Visit:** When a user navigates to a new module for the first time, a modal offers a 2-minute guided walkthrough.
- **Interactive Spotlight Engine:** Uses an SVG mask to spotlight active interface elements while displaying step-by-step contextual guidance popovers.
- **Adoption Analytics:** Administrators monitor organizational training completion rates by module and role.

12.4 In-App Notifications Center & Operational Triggers

The header notification bell provides instant alerts for operational events:

- PO approvals requested above threshold
- Stock adjustments pending dual-authorization
- Reorder point breaches detected by the nightly scheduler
- Lots approaching expiration within 30 days

Appendix: Operational Best Practices & Invariants

To maintain system integrity and audit readiness, all manufacturing operating personnel must adhere to the core principles below:

LEDGER INTEGRITY PRINCIPLE

Never attempt to bypass standard workflows through direct database intervention. Every adjustment, receipt, transfer, and consumption must possess an auditable human reason code and document reference. The stock ledger is append-only by design; mistakes are corrected through offsetting compensatory entries, not retroactive deletions.

SEGREGATION OF DUTIES PRINCIPLE

Procurement and inventory write-off thresholds exist to satisfy legal and financial compliance frameworks. Users must never share credentials or delegate administrative accounts. Dual authorization ensures fraud prevention and operational transparency.

RECALL READINESS BEST PRACTICE

When receiving lot-tracked raw materials, receiving clerks must verify vendor certificate-of-analysis (COA) batch numbers before confirming intake. Accurate upstream lot recording ensures that downstream recall simulations accurately isolate affected production batches within seconds.

Apex Manufacturing IMS Operations Manual

Official Documentation • Product Version 2.4.0 • Enterprise Operations Suite

Apex Industrial Solutions Inc. • All Rights Reserved • ISO 9001 / 21 CFR Part 11 Aligned Architecture