

# MES Production Confirmation - Detailed Agile System Audit

Date: 2026-02-12 | Version: 1.0 | Audit Type: Full System

## A. Module Inventory

#	Module	Business Purpose	Screen Count	APIs Used	Key Services	Status	Completion %
1	Auth	User login, JWT token management	1	4	AuthService, JwtService	Complete	100%
2	Dashboard	KPIs, recent activity, summary metrics	1	2	DashboardService	Complete	100%
3	Orders	Customer order lifecycle management	3	10	OrderService	Complete	100%
4	Production	Production confirmation, reversal, history	3	10	ProductionService, BomValidationService	Complete	100%
5	Inventory	Material stock management, state transitions	4	17	InventoryService, ReceiveMaterialService	Complete	100%
6	Batches	Batch lifecycle, genealogy, split/merge	3	22	BatchService, BatchNumberService	Complete	100%
7	Holds	Hold/release on any entity	3	6	HoldService	Complete	100%
8	Equipment	Equipment CRUD, maintenance, holds	3	13	EquipmentService	Complete	95%
9	Operations	Operation tracking, status management	2	6	OperationService	Complete	95%
10	Customers	Customer master data CRUD	3	7	CustomerService	Complete	100%
11	Materials	Material master data CRUD	3	7	MaterialService	Complete	95%
12	Products	Product master data CRUD	3	7	ProductService	Complete	95%
13	Operators	Operator master data CRUD	3	6	OperatorService	Complete	100%
14	Processes	Process definition management	4	6	ProcessService	Complete	100%
15	Routing	Production routing with steps	3	20+	RoutingService	Complete	95%

16	<b>Operation Templates</b>	Reusable operation blueprints	3	5	OperationTemplateService	Complete	100%
17	<b>BOM</b>	Bill of Materials tree management	3	18	BomService, BomValidationService	Complete	95%
18	<b>Configuration</b>	6 config sub-modules (hold/delay reasons, params, batch number/size, quantity type)	12	30+	6 config services	Complete	100%
19	<b>Reports</b>	7 report types + executive dashboard	8	8	ReportAnalyticsService, ChartService	Complete	100%
20	<b>Users</b>	User management CRUD	3	9	UserService	Complete	100%
21	<b>Audit</b>	Audit trail browsing, filtering	1	8	AuditService, FieldChangeAuditService	Complete	100%
22	<b>Profile</b>	User profile, password change	2	3	UserService	Complete	100%

## B. Screen Inventory Table

Screen Name	Module	Type	API Endpoints Used	Role Access	Validation Level	Tt Cov (U/I)
LoginComponent	Auth	Execution	POST /auth/login	Public	Email + Password required	9/13
DashboardComponent	Dashboard	Report	GET /dashboard/summary	Authenticated	N/A	6/19
OrderListComponent	Orders	Execution	GET /orders/paged	Authenticated	Search/filter validation	15/1
OrderDetailComponent	Orders	Execution	GET /orders/{id}	Authenticated	N/A	-/47
OrderFormComponent	Orders	Execution	POST /orders, PUT /orders/{id}	Authenticated	Customer, line items required	-/34
ProductionLandingComponent	Production	Execution	GET /orders/available	Authenticated	N/A	-/17
ProductionConfirmComponent	Production	Execution	POST /production/confirm, GET /bom/, GET /batches/	Authenticated	BOM validation, parameter ranges, quantity checks	25/6
ProductionHistoryComponent	Production	Report	GET /production/confirmations	Authenticated	Date range filter	-/18

InventoryListComponent	Inventory	Execution	GET /inventory/paged	Authenticated	State/type filter	34/3
InventoryDetailComponent	Inventory	Execution	GET /inventory/{id}	Authenticated	N/A	-/24
InventoryFormComponent	Inventory	Execution	POST /inventory, PUT /inventory/{id}	Authenticated	Material, quantity required	-/12
ReceiveMaterialComponent	Inventory	Execution	POST /inventory/receive-material	Authenticated	Material, quantity, supplier required	-/25
BatchListComponent	Batches	Execution	GET /batches/paged	Authenticated	Status filter	42/1
BatchDetailComponent	Batches	Execution	GET /batches/{id}, GET /batches/{id}/genealogy	Authenticated	N/A	-/45
BatchFormComponent	Batches	Execution	POST /batches/{id}/split, POST /batches/merge	Authenticated	Quantity validation, invariant checks	-/11
HoldListComponent	Holds	Execution	GET /holds/paged	Authenticated	Entity type filter	32/2
HoldDetailComponent	Holds	Execution	GET /holds/{id}	Authenticated	N/A	-/21
HoldFormComponent	Holds	Execution	POST /holds, PUT /holds/{id}/release	Authenticated	Entity type, reason required	-/9/-
EquipmentListComponent	Equipment	Master	GET /equipment/paged	Authenticated	Status filter	23/2
EquipmentDetailComponent	Equipment	Master	GET /equipment/{id}	Authenticated	N/A	-/19
EquipmentFormComponent	Equipment	Master	POST /equipment, PUT /equipment/{id}	Authenticated	Code, name, type required	-/12
OperationListComponent	Operations	Execution	GET /operations/paged	Authenticated	Status/type filter	29/2
OperationDetailComponent	Operations	Execution	GET /operations/{id}	Authenticated	N/A	-/22
CustomerListComponent	Customers	Master	GET /customers/paged	Authenticated	Search filter	15/1
CustomerDetailComponent	Customers	Master	GET /customers/{id}	Authenticated	N/A	-/14
CustomerFormComponent	Customers	Master	POST /customers, PUT /customers/{id}	Authenticated	Code, name required	-/13
MaterialListComponent	Materials	Master	GET /materials/paged	Authenticated	Type filter	19/1
MaterialDetailComponent	Materials	Master	GET /materials/{id}	Authenticated	N/A	-/14
MaterialFormComponent	Materials	Master	POST /materials, PUT /materials/{id}	Authenticated	Code, name, type, UOM required	-/21

ProductListComponent	Products	Master	GET /products/paged	Authenticated	Category filter	15/1
ProductDetailComponent	Products	Master	GET /products/{id}	Authenticated	N/A	-/10
ProductFormComponent	Products	Master	POST /products, PUT /products/{id}	Authenticated	SKU, name required	-/25
BomListComponent	BOM	Planning	GET /bom/products	Authenticated	Search filter	29/3
BomTreeComponent	BOM	Planning	GET /bom/{sku}/tree	Authenticated	N/A	-/46
BomNodeFormComponent	BOM	Planning	POST /bom/node, PUT /bom/node/{id}	Authenticated	Material, quantity, yield required	-/39
OperatorListComponent	Operators	Master	GET /operators/paged	Authenticated	Status filter	11/1
OperatorDetailComponent	Operators	Master	GET /operators/{id}	Authenticated	N/A	-/14
OperatorFormComponent	Operators	Master	POST /operators, PUT /operators/{id}	Authenticated	Code, name required	-/18
ProcessListComponent	Processes	Planning	GET /processes/paged	Authenticated	Status filter	27/2
ProcessDetailComponent	Processes	Planning	GET /processes/{id}	Authenticated	N/A	-/22
ProcessFormComponent	Processes	Planning	POST /processes, PUT /processes/{id}	Authenticated	Name required	-/24
QualityPendingComponent	Processes	Execution	GET /batches/pending-approval	Authenticated	N/A	-/3/-
RoutingListComponent	Routing	Planning	GET /routing/paged	Authenticated	Status filter	35/4
RoutingDetailComponent	Routing	Planning	GET /routing/{id}	Authenticated	N/A	-/25
RoutingFormComponent	Routing	Planning	POST /routing, PUT /routing/{id}	Authenticated	Name, process required	-/53
OpTemplateListComponent	Templates	Planning	GET /operation-templates	Authenticated	Search filter	12/4
OpTemplateDetailComponent	Templates	Planning	GET /operation-templates/{id}	Authenticated	N/A	-/19
HoldReasonsListComponent	Config	Config	GET /config/hold-reasons/paged	Authenticated	Search filter	-/16
HoldReasonsFormComponent	Config	Config	POST/PUT /config/hold-reasons	Authenticated	Code, description required	-/24
DelayReasonsListComponent	Config	Config	GET /config/delay-reasons/paged	Authenticated	Search filter	-/16
DelayReasonsFormComponent	Config	Config	POST/PUT /config/delay-reasons	Authenticated	Code, description required	-/16

ProcessParamsListComponent	Config	Config	GET /config/process-parameters/paged	Authenticated	Process filter	-/15
ProcessParamsFormComponent	Config	Config	POST/PUT /config/process-parameters	Authenticated	Name, type, min/max required	-/14
QuantityTypeListComponent	Config	Config	GET /config/quantity-type/paged	Authenticated	Search filter	-/16
QuantityTypeFormComponent	Config	Config	POST/PUT /config/quantity-type	Authenticated	Code, description required	-/20
BatchNumberListComponent	Config	Config	GET /batch-number-config/paged	Authenticated	Type filter	-/18
BatchNumberFormComponent	Config	Config	POST/PUT /batch-number-config	Authenticated	Prefix, format required	-/25
BatchSizeListComponent	Config	Config	GET /batch-size-config/paged	Authenticated	Type filter	-/18
BatchSizeFormComponent	Config	Config	POST/PUT /batch-size-config	Authenticated	Min, max, standard required	-/21
UserListComponent	Users	Admin	GET /users/paged	Authenticated	Role filter	19/1
UserDetailComponent	Users	Admin	GET /users/{id}	Authenticated	N/A	-/13
UserFormComponent	Users	Admin	POST /users, PUT /users/{id}	Authenticated	Username, email, role required	-/13
AuditListComponent	Audit	Admin	GET /audit/paged	Authenticated	Entity type, action, date filters	17/2
ReportsLandingComponent	Reports	Report	N/A	Authenticated	N/A	-/4/-
ExecutiveDashboardComponent	Reports	Report	GET /analytics/executive-dashboard	Authenticated	Date range	-/13
ProductionSummaryComponent	Reports	Report	GET /reports/production-summary	Authenticated	Date range	-/8/-
ScrapAnalysisComponent	Reports	Report	GET /analytics/scrap-analysis	Authenticated	Date range	-/7/-
OrderFulfillmentComponent	Reports	Report	GET /reports/order-fulfillment	Authenticated	Date range	-/6/-
InventoryBalanceComponent	Reports	Report	GET /reports/inventory-balance	Authenticated	Type filter	-/11
OperationsReportComponent	Reports	Report	GET /analytics/operations	Authenticated	Date range	-/7/-
ProfileComponent	Profile	Admin	GET /auth/me	Authenticated	N/A	-/9/-

ChangePasswordComponent	Profile	Admin	POST /users/change-password	Authenticated	Current + new + confirm required	-/21
MaterialSelectionModal	Shared	Execution	GET /batches/available	Authenticated	Quantity <= available	-/21
ApplyHoldModal	Shared	Execution	POST /holds	Authenticated	Reason required	-/23

## C. Services Documentation

### Backend Services (42 Total)

#	Service	Responsibility	API Routes	DB Tables
1	<b>AuthService</b>	JWT login, token refresh, user lookup	/auth/*	users
2	<b>OrderService</b>	Order CRUD, line item management, status transitions	/orders/*	orders, order_line_items
3	<b>ProductionService</b>	Confirm production, manage consumption, reversal	/production/*	production_confirmation, consumed_materials, produced_outputs
4	<b>BatchService</b>	Batch lifecycle, split/merge, genealogy, approval	/batches/*	batches, batch_relations
5	<b>InventoryService</b>	Stock CRUD, state transitions (block/scrap/reserve)	/inventory/*	inventory
6	<b>HoldService</b>	Apply/release holds on any entity	/holds/*	holds, hold_reasons
7	<b>EquipmentService</b>	Equipment CRUD, maintenance/hold status	/equipment/*	equipment
8	<b>BomService</b>	BOM tree CRUD, versioning, hierarchy	/bom/*	bill_of_materials
9	<b>BomValidationService</b>	BOM requirements, suggested consumption, validation	/bom/validate, /bom/operation/*/suggested-consumption	bill_of_materials, batches, inventory

10	<b>CustomerService</b>	Customer master CRUD	/customers/*	customers
11	<b>MaterialService</b>	Material master CRUD	/materials/*	materials
12	<b>ProductService</b>	Product master CRUD	/products/*	products
13	<b>OperationService</b>	Operation status management	/operations/*	operations
14	<b>OperationTemplateService</b>	Reusable operation blueprint CRUD	/operation-templates/*	operation_templates
15	<b>OperatorService</b>	Operator master CRUD	/operators/*	operators
16	<b>RoutingService</b>	Routing CRUD, step management, activation	/routing/*	routings, routing_steps
17	<b>ProcessService</b>	Process definition CRUD	/processes/*	processes
18	<b>AuditService</b>	Audit trail queries, entity history, date ranges	/audit/*	audit_trail
19	<b>FieldChangeAuditService</b>	Field-level diff and audit logging	(internal)	audit_trail
20	<b>DashboardService</b>	Aggregate metrics for dashboard	/dashboard/*	Multiple (aggregated)
21	<b>BatchNumberService</b>	Configurable batch number generation	(internal)	batch_number_config, batch_number_sequence
22	<b>BatchNumberConfigService</b>	Batch number config CRUD	/batch-number-config/*	batch_number_config
23	<b>BatchSizeService</b>	Batch size config management	/batch-size-config/*	batch_size_config
24	<b>ProcessParameterService</b>	Validate process parameters against config	(internal)	process_parameters_config
25	<b>ProcessParametersConfigService</b>	Parameter config CRUD	/config/process-parameters/*	process_parameters_config
26	<b>QuantityTypeConfigService</b>	Quantity type config CRUD	/config/quantity-type/*	quantity_type_config
27	<b>HoldReasonService</b>	Hold reason config CRUD	/config/hold-reasons/*	hold_reasons

28	<b>DelayReasonService</b>	Delay reason config CRUD	/config/delay-reasons/*	delay_reasons
29	<b>InventoryFormService</b>	Inventory form options	(internal)	inventory_form_config
30	<b>InventoryMovementService</b>	Movement logging for inventory changes	/inventory-movements/*	inventory_movements
31	<b>EquipmentCategoryService</b>	Equipment classification	(internal)	equipment
32	<b>EquipmentUsageService</b>	Track equipment usage per operation	/equipment-usage/*	operation_equipment_usage
33	<b>ReceiveMaterialService</b>	Goods receipt (batch + inventory creation)	POST /inventory/receive- material	batches, inventory
34	<b>BatchAllocationService</b>	Batch-to-order allocation	/batch-allocation/*	batch_order_allocation
35	<b>UnitConversionService</b>	Unit of measure conversion	(internal)	unit_of_measure, unit_conversion
36	<b>UserService</b>	User CRUD, password management	/users/*	users
37	<b>OperationInstantiationService</b>	Create operations from routing templates	(internal)	operations, routing_steps
38	<b>ReportAnalyticsService</b>	Analytics queries for reports	/analytics/*	Multiple (aggregated)
39	<b>ChartService</b>	Chart data formatting	(internal)	N/A
40	<b>ExcelExportService</b>	Excel file generation	/reports/export/*	Multiple
41	<b>PdfReportService</b>	PDF report generation	/reports/export/*	Multiple
42	<b>ImageProcessingService</b>	Image processing utilities	(internal)	N/A

## D. Data Layer Overview

### Core Entities (11)



Entity	Table	Purpose	Key Relationships
Order	orders	Customer order	Has many OrderLineItems; FK to Customer
OrderLineItem	order_line_items	Products in order	FK to Order; Has many Operations
Operation	operations	Production step	FK to Process, OrderLineItem, RoutingStep
ProductionConfirmation	production_confirmation	Confirmation record	FK to Operation; Has ConsumedMaterials, ProducedOutputs
Batch	batches	Trackable material unit	Has many Inventory, BatchRelations
Inventory	inventory	Material stock record	FK to Batch; State machine (AVAILABLE/BLOCKED/etc.)
Equipment	equipment	Machine/tool	Has EquipmentUsage records
HoldRecord	holds	Hold/release record	Polymorphic FK (any entity type)
ConsumedMaterial	consumed_materials	Input consumption	FK to Confirmation, Inventory, Batch
ProducedOutput	produced_outputs	Output production	FK to Confirmation, Batch
BatchRelation	batch_relations	Parent-child genealogy	FK to Batch (parent + child)

Master Data Tables (8)

Entity	Table	Purpose
Customer	customers	Customer master
Material	materials	Material master (RM/IM/FG/WIP)
Product	products	Product master (SKU)
Operator	operators	Personnel master
Process	processes	Process definitions
OperationTemplate	operation_templates	Reusable operation blueprints
Routing	routings	Production routing
RoutingStep	routing_steps	Steps within routing

Configuration Tables (10)

Entity	Table	Purpose
BatchNumberConfig	batch_number_config	Batch number generation rules
BatchSizeConfig	batch_size_config	Min/max/standard batch sizes
ProcessParametersConfig	process_parameters_config	Parameter min/max/default per process
QuantityTypeConfig	quantity_type_config	Quantity type rules
HoldReason	hold_reasons	Configurable hold reasons

DelayReason	delay_reasons	Configurable delay reasons
BillOfMaterial	bill_of_materials	Hierarchical BOM tree
UnitOfMeasure	units_of_measure	UOM reference
UnitConversion	unit_conversion	Conversion factors
InventoryFormConfig	inventory_form_config	Inventory form options

### Audit & System Tables (5)

Entity	Table	Purpose
AuditTrail	audit_trail	All entity change history (JSON)
DatabasePatch	database_patches	Applied SQL patch tracker
User	users	Authentication & authorization
InventoryMovement	inventory_movements	Inventory state change log
BatchQuantityAdjustment	batch_quantity_adjustments	Batch quantity change log

### Multi-Tenant Handling

- **Not applicable** - Single-tenant design
- Tenant isolation would require schema-per-tenant or row-level security for production

## E. Business Workflow Documentation

### Lifecycle Sequence

#### 1. System Initialization

Attribute	Value
<b>Entry Trigger</b>	Application startup (Spring Boot)
<b>Screens</b>	None (automatic)
<b>Services</b>	PatchService, PatchRunner, TestPatchRunner
<b>Entities</b>	DatabasePatch
<b>Validation</b>	Patch idempotency (IF NOT EXISTS)
<b>Test Coverage</b>	PatchServiceTest (8), PatchRunnerTest (5)
<b>Gaps</b>	None

#### 2. Master Data Setup

Attribute	Value
<b>Entry Trigger</b>	Admin navigates to /manage/*
<b>Screens</b>	CustomerList/Form, MaterialList/Form, ProductList/Form, OperatorList/Form, EquipmentList/Form
<b>Services</b>	CustomerService, MaterialService, ProductService, OperatorService, EquipmentService

<b>Entities</b>	Customer, Material, Product, Operator, Equipment
<b>Validation</b>	Unique codes, required fields, soft delete
<b>Test Coverage</b>	Full CRUD tests per entity
<b>Gaps</b>	GAP-021 (Equipment category), GAP-022 (Extended fields)

### 3. Configuration Setup

Attribute	Value
<b>Entry Trigger</b>	Admin navigates to /manage/config/*
<b>Screens</b>	12 config screens (6 list + 6 form)
<b>Services</b>	HoldReasonService, DelayReasonService, ProcessParametersConfigService, BatchNumberConfigService, QuantityTypeConfigService, BatchSizeService
<b>Entities</b>	HoldReason, DelayReason, ProcessParametersConfig, BatchNumberConfig, QuantityTypeConfig, BatchSizeConfig
<b>Validation</b>	Unique codes, range validation, required fields
<b>Test Coverage</b>	41 backend + 158 frontend + 34 E2E tests
<b>Gaps</b>	None

### 4. Design & Planning

Attribute	Value
<b>Entry Trigger</b>	Admin defines production processes and BOM
<b>Screens</b>	ProcessList/Form, RoutingList/Form, OpTemplateList, BomList/Tree/NodeForm
<b>Services</b>	ProcessService, RoutingService, OperationTemplateService, BomService
<b>Entities</b>	Process, Routing, RoutingStep, OperationTemplate, BillOfMaterial
<b>Validation</b>	Routing activation rules, BOM hierarchy integrity, step sequencing
<b>Test Coverage</b>	35 routing + 29 BOM + 27 process backend tests
<b>Gaps</b>	GAP-017 (Routing pagination), GAP-018 (BOM pagination)

### 5. Execution

Attribute	Value
<b>Entry Trigger</b>	Order creation or material receipt
<b>Screens</b>	OrderList/Form, ReceiveMaterial, ProductionConfirm, InventoryList, BatchList, HoldList
<b>Services</b>	OrderService, ReceiveMaterialService, ProductionService, InventoryService, BatchService, HoldService, OperationInstantiationService
<b>Entities</b>	Order, OrderLineItem, Operation, ProductionConfirmation, ConsumedMaterial, ProducedOutput, Batch, Inventory, HoldRecord
<b>Validation</b>	BOM consumption, process parameters, batch invariants, hold checks, quantity validation

<b>Test Coverage</b>	25+42+34+32 backend + 102+67+71+58 frontend + 102+43+21+5 E2E tests
<b>Gaps</b>	GAP-016 (Operations pagination)

## 6. Monitoring

Attribute	Value
<b>Entry Trigger</b>	Dashboard access, audit trail queries
<b>Screens</b>	Dashboard, AuditList
<b>Services</b>	DashboardService, AuditService, FieldChangeAuditService
<b>Entities</b>	AuditTrail (aggregated queries)
<b>Validation</b>	Date range, entity type filters
<b>Test Coverage</b>	6+17 backend + 19+25 frontend + 24+29 E2E tests
<b>Gaps</b>	None

## 7. Reporting

Attribute	Value
<b>Entry Trigger</b>	User navigates to /reports
<b>Screens</b>	ReportsLanding, ExecutiveDashboard, ProductionSummary, ScrapAnalysis, OrderFulfillment, InventoryBalance, OperationsReport
<b>Services</b>	ReportAnalyticsService, ChartService, ExcelExportService, PdfReportService
<b>Entities</b>	Aggregated queries across all tables
<b>Validation</b>	Date range validation
<b>Test Coverage</b>	24 backend + 64 frontend + 24 E2E tests
<b>Gaps</b>	None

## 8. Administration

Attribute	Value
<b>Entry Trigger</b>	Admin navigates to /manage/users
<b>Screens</b>	UserList/Form, Profile, ChangePassword
<b>Services</b>	UserService, AuthService
<b>Entities</b>	User
<b>Validation</b>	Email uniqueness, password strength, role assignment
<b>Test Coverage</b>	19 backend + 39+30 frontend + 14+18 E2E tests
<b>Gaps</b>	No RBAC beyond admin role

## High-Level System Flow

flowchart TD

```
A[System Start] --> B[Patch Runner<br/>51 SQL patches]
B --> C{Profile?}
C -->|Production| D[PostgreSQL]
C -->|Demo| E[H2 In-Memory]
C -->|Test| F[PostgreSQL mes_test<br/>Schema Reset]
```

```
D --> G[Application Ready]
E --> G
F --> G
```

```
G --> H[Login<br/>JWT Auth]
H --> I[Dashboard<br/>KPIs & Metrics]
```

```
I --> J[Master Data Setup]
J --> J1[Customers]
J --> J2[Materials]
J --> J3[Products]
J --> J4[Equipment]
J --> J5[Operators]
```

```
I --> K[Design & Planning]
K --> K1[Processes]
K --> K2[Routing + Steps]
K --> K3[Operation Templates]
K --> K4[BOM Tree]
K --> K5[Configuration]
```

```
I --> L[Execution Workflow]
L --> L1[Create Order]
L1 --> L2[Operations Instantiated<br/>from Routing]
L2 --> L3[Receive Material<br/>Goods Receipt]
L3 --> L4[Production Confirmation<br/>BOM + Parameters]
L4 --> L5{Partial?}
L5 -->|Yes| L6[Save Partial<br/>Continue Later]
L5 -->|No| L7[Confirm Complete]
L6 --> L4
L7 --> L8[Output Batch Created<br/>Inventory Updated]
L8 --> L9[Batch Split/Merge<br/>if needed]
L9 --> L10[Next Operation<br/>or Order Complete]
```

```
L4 --> L11[Hold Applied?]
L11 -->|Yes| L12[Hold Management<br/>Apply/Release]
L12 --> L4
```

```
I --> M[Monitoring]
M --> M1[Audit Trail<br/>Field-Level Changes]
M --> M2[Batch Genealogy<br/>Traceability]
```

```
I --> N[Reporting]
N --> N1[Executive Dashboard]
N --> N2[Production Summary]
N --> N3[Scrap Analysis]
```

N --> N4[Order Fulfillment]  
 N --> N5[Inventory Balance]  
 N --> N6[PDF/Excel Export]

I --> O[Administration]  
 O --> O1[User Management]  
 O --> O2[Password Change]

## F. E2E Coverage Mapping

#	Business Flow	Covered?	Test File	Criticality	Data Dependency	Regression?
1	User Login/Logout	Yes	01-auth.test.js	Critical	User credentials	Yes
2	Dashboard Metrics	Yes	02-dashboard.test.js, 38-dashboard-features.test.js	High	Seeded data	Yes
3	Order List & Filters	Yes	03-orders.test.js	High	Seeded orders	Yes
4	Order CRUD	Yes	32-order-crud.test.js, 11-crud.test.js	Critical	Customers, Products	Yes
5	Production Confirmation	Yes	04-production.test.js, 33-production-complete.test.js	Critical	Orders, Materials, BOM	Yes
6	Partial Confirmation	Yes	24-partial-confirmation.test.js	High	Active operations	Yes
7	Material Receipt	Yes	34-receive-material.test.js	Critical	Materials	Yes
8	Inventory Management	Yes	05-inventory.test.js	High	Batches, Materials	Yes
9	Batch List & Genealogy	Yes	06-batches.test.js, 35-batch-operations.test.js	Critical	Production data	Yes
10	Batch Split/Merge	Yes	35-batch-operations.test.js	High	Available batches	Yes
11	Hold Apply/Release	Yes	07-holds.test.js	High	Any entity	Yes
12	Equipment Management	Yes	08-equipment.test.js	Medium	Equipment master	Yes
13	Quality Inspection	Yes	09-quality.test.js	High	Pending batches	Yes
14	Pagination (all lists)	Yes	10-pagination.test.js	Medium	Seeded data	Yes
15	Master Data CRUD	Yes	11-crud.test.js, 12-entity-crud.test.js	High	None	Yes
16	BOM CRUD	Yes	13-bom-crud.test.js	High	Products, Materials	Yes

17	Config CRUD	Yes	14-config-crud.test.js	Medium	None	Yes
18	Audit Trail	Yes	15-audit-history.test.js	High	Any entity changes	Yes
19	Routing Design	Yes	22-routing.test.js, 36-routing-crud.test.js	High	Processes, Templates	Yes
20	Operation Templates	Yes	37-operation-templates.test.js	Medium	None	Yes
21	Full Workflow (E2E)	Yes	30-full-workflow-setup.test.js, 40-e2e-workflow-verification.test.js, 41-production-flow-e2e.test.js	Critical	Full setup	Yes
22	Form Validations	Yes	39-form-validations.test.js	Medium	None	Yes
23	Reports	Yes	48-reports.test.js	Medium	Production data	Yes
24	Mobile Responsive	Yes	49-mobile-responsive.test.js, 50-responsive-breakpoints.test.js	Medium	Any page	Yes
25	Auth Security	Yes	51-auth-security.test.js	Critical	None	Yes
26	API Error Handling	Yes	52-api-error-handling.test.js	High	None	Yes
27	Page Validation	Yes	53-page-level-validation.test.js	Medium	None	Yes
28	User Management	Yes	20-users.test.js	Medium	None	Yes
29	Password Change	Yes	43-change-password.test.js	Medium	User account	Yes

## G. Test Pyramid Overview

Layer	Test Count	% of Total	Framework	Automation
Backend Unit Tests	1,337	37%	JUnit 5 + Mockito	./gradlew test
Frontend Component Tests	1,524	43%	Karma + Jasmine	npx ng test
E2E Tests	719	20%	Playwright	node run-all-tests.js
Manual Tests	0 (documented)	-	N/A	N/A
TOTAL	3,580	100%	3 frameworks	Local runners

### Automation Maturity Score: 7/10

Criterion	Score	Notes
Test automation coverage	9/10	All 3 layers automated
CI/CD integration	2/10	No pipeline configured
Code coverage reporting	3/10	No JaCoCo/Istanbul

Test data management	7/10	Demo mode + patch system
Regression suite	8/10	run-tests.bat orchestrates all
Performance testing	1/10	Not implemented
Security testing	5/10	Basic auth E2E only

## H. CI/CD Integration

Attribute	Status
CI/CD Platform	Not configured
Trigger Conditions	N/A - Manual execution only
Test Execution Stage	Manual: run-tests.bat
Deployment Gating	None - No automated quality gates
Reporting Visibility	Console output only
Artifact Storage	Local (e2e/output/screenshots/)

### Current Test Execution Model

Manual Trigger

└─ run-tests.bat --backend

→ ./gradlew test (PostgreSQL mes\_test)

└─ run-tests.bat --frontend

→ npx ng test --browsers=ChromeHeadless

└─ run-tests.bat --e2e

→ node e2e/run-all-tests.js (Playwright)

### Recommended CI/CD Pipeline (Not Yet Implemented)

Push to main

└─ Stage 1: Build

└─ ./gradlew build

└─ npm run build

└─ Stage 2: Test

└─ ./gradlew test (backend)

└─ npx ng test (frontend)

└─ node run-all-tests.js (E2E)

└─ Stage 3: Quality Gate

└─ JaCoCo coverage > 70%

└─ Istanbul coverage > 70%

└─ All E2E pass

└─ Stage 4: Deploy (manual approval)

## I. Open Gaps & Action Plan

#	Gap Description	Severity	Area	Suggested Action	Owner
1	Operations list uses client-side pagination (GAP-016)	HIGH	Backend + Frontend	Add server-side /operations/paged endpoint + update component	TBD



2	Routing list uses client-side pagination (GAP-017)	HIGH	Backend + Frontend	Add server-side /routing/paged endpoint + update component	TBD
3	BOM products list uses client-side pagination (GAP-018)	MEDIUM	Backend + Frontend	Add server-side /bom/products/paged endpoint + update component	TBD
4	Equipment category field missing (GAP-021)	MEDIUM	Data Model	Add category field to Equipment entity + SQL patch	TBD
5	Material/Product extended fields missing (GAP-022)	LOW	Data Model	Add cost, threshold, weight fields + SQL patch	TBD
6	No CI/CD pipeline configured	HIGH	DevOps	Set up GitHub Actions or Jenkins pipeline	TBD
7	No code coverage metrics (JaCoCo/Istanbul)	MEDIUM	Testing	Integrate coverage tools into build	TBD
8	No RBAC beyond admin role	MEDIUM	Security	Implement role-based access (VIEWER, OPERATOR, SUPERVISOR, ADMIN)	TBD
9	No Swagger/OpenAPI documentation	LOW	API	Add springdoc-openapi dependency	TBD
10	No Docker containerization	MEDIUM	DevOps	Create Dockerfile + docker-compose.yml	TBD
11	No performance/load testing	LOW	Testing	Add JMeter or k6 scripts for key workflows	TBD
12	No application monitoring (APM)	MEDIUM	Operations	Add Spring Boot Actuator + Prometheus/Grafana	TBD
13	No centralized logging	LOW	Operations	Add ELK stack or CloudWatch integration	TBD
14	Custom SQL patch system vs Flyway/Liquibase	LOW	Data	Evaluate migration to standard tool	TBD
15	No database backup strategy	MEDIUM	Operations	Configure pg_dump schedule	TBD