MES Production Confirmation POC - Specification

Document Version: 1.0 **Project:** Bluemingo MES POC

1. Project Overview

1.1 Purpose

This Proof of Concept (POC) demonstrates a Manufacturing Execution System (MES) focused on production confirmation workflows, material consumption tracking, and batch traceability for steel manufacturing environments.

1.2 POC Scope

The POC covers the following core screens:

- **Login** - User authentication
- **Dashboard** - Production metrics and status overview
- **Orders** - Order management and tracking
- **Production Confirmation** - Confirm production with material consumption
- **Batches/Traceability** - Batch genealogy and tracking
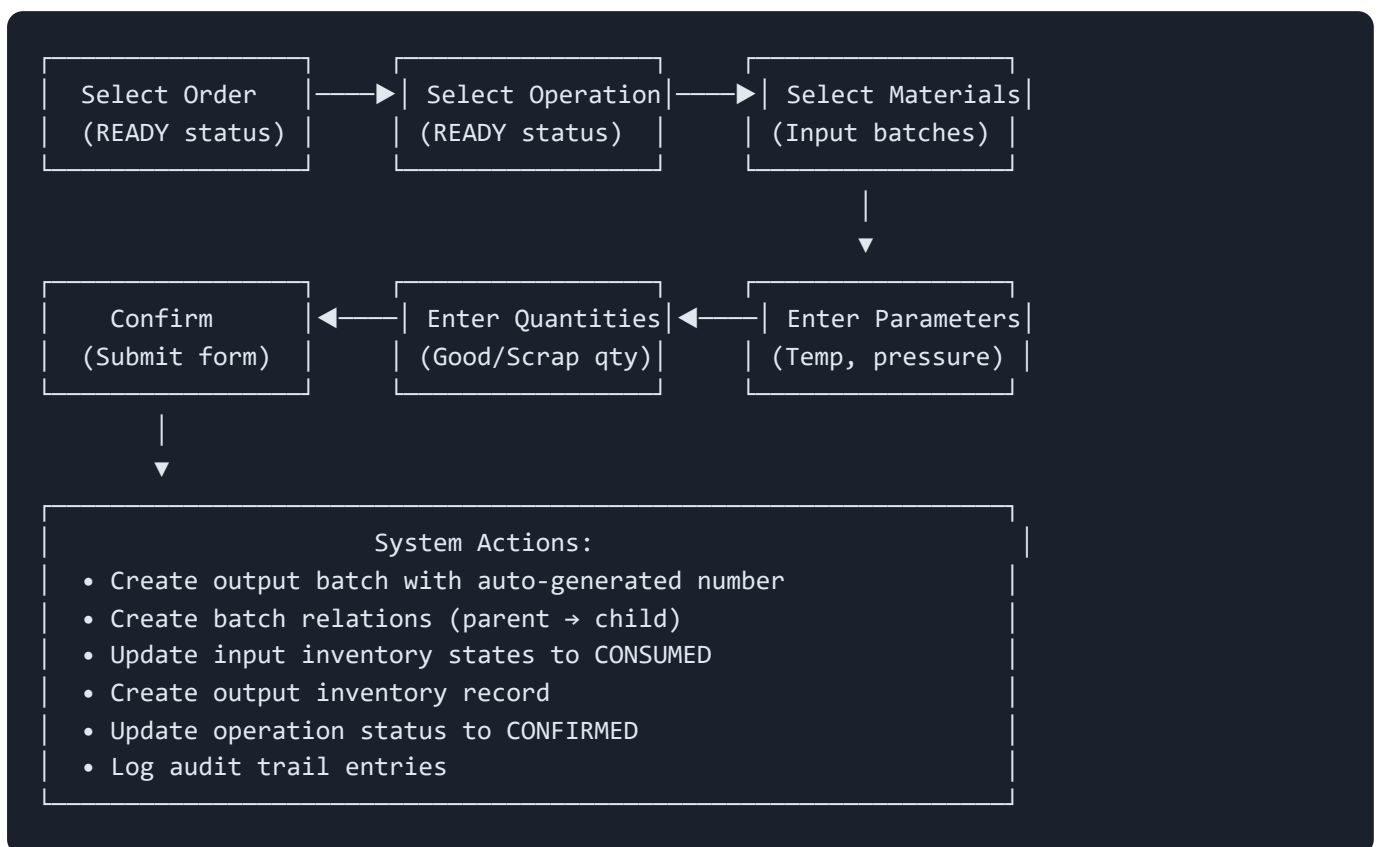
1.3 Out of Scope

- ERP integration
- Real-time machine data collection (IoT)
- Advanced scheduling and planning
- Detailed costing and financials
- Multi-plant/multi-site support
- Administrative configuration screens

2. Business Objectives

Objective	Success Criteria
Demonstrate production confirmation workflow	Complete end-to-end confirmation with all data captured
Show batch traceability	Forward and backward genealogy navigation
Validate inventory state management	Track all inventory state transitions
Enable equipment/operator tracking	Associate resources with production

3. Key Workflows

3.1 Production Confirmation Workflow

```
┌──────────────────────┐     ┌──────────────────────┐     ┌──────────────────────┐
│   Select Order       │────▶│   Select Operation   │────▶│   Select Materials   │
│   (READY status)     │     │   (READY status)     │     │   (Input batches)    │
└──────────────────────┘     └──────────────────────┘     └──────────────────────┘
                                                                      │
                                                                      ▼
┌──────────────────────┐     ┌──────────────────────┐     ┌──────────────────────┐
│      Confirm         │◀────│   Enter Quantities   │◀────│   Enter Parameters   │
│   (Submit form)      │     │   (Good/Scrap qty)   │     │   (Temp, pressure)   │
└──────────────────────┘     └──────────────────────┘     └──────────────────────┘
          │
          ▼
┌──────────────────────────────────────────────────────────────────────────────┐
│                            System Actions:                                     │
│   • Create output batch with auto-generated number                            │
│   • Create batch relations (parent → child)                                   │
│   • Update input inventory states to CONSUMED                                  │
│   • Create output inventory record                                            │
│   • Update operation status to CONFIRMED                                       │
│   • Log audit trail entries                                                    │
└──────────────────────────────────────────────────────────────────────────────┘
```

3.2 Batch Genealogy Workflow

```
Forward Traceability:
Raw Material → Intermediate → Finished Good
     ↓              ↓              ↓
 BATCH-RM-001 → BATCH-IM-001 → BATCH-FG-001

Backward Traceability:
Finished Good → Intermediate → Raw Material
     ↓              ↓              ↓
 BATCH-FG-001 → BATCH-IM-001 → BATCH-RM-001
```
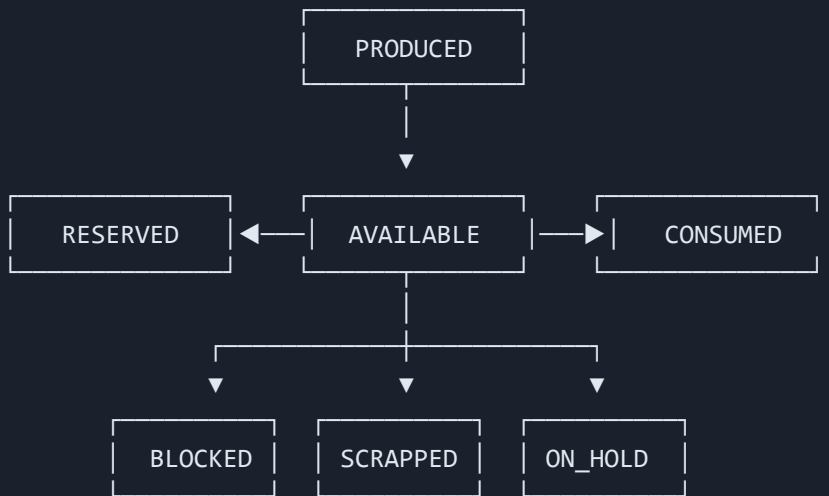
3.3 Inventory State Transitions

```
                    ┌──────────────┐
                    │   PRODUCED   │
                    └──────────────┘
                           │
                           ▼
┌──────────────┐    ┌──────────────┐    ┌──────────────┐
│   RESERVED   │◄───┤  AVAILABLE   ├───►│   CONSUMED   │
└──────────────┘    └──────────────┘    └──────────────┘
                           │
               ┌───────────┼───────────┐
               ▼           ▼           ▼
        ┌──────────┐ ┌──────────┐ ┌──────────┐
        │ BLOCKED  │ │ SCRAPPED │ │ ON_HOLD  │
        └──────────┘ └──────────┘ └──────────┘
```

4. Technical Architecture

4.1 System Components

```
+----------------------------------------------------------+
| Frontend (Angular 17)                                   |
| +-----------+ +---------+ +------------+ +----------+    |
| |Dashboard  | | Orders  | |Production  | | Batches  |    |
| +-----------+ +---------+ +------------+ +----------+    |
+----------------------------------------------------------+
              | HTTP/REST
              ▼
+----------------------------------------------------------+
| Backend (Spring Boot 3.2)                               |
| +-----------+ +-----------+ +-------------+              |
| |Controllers| | Services  | |Repositories |              |
| +-----------+ +-----------+ +-------------+              |
|                    |                                     |
|             +-----------------+                          |
|             | JWT Security    |                          |
|             +-----------------+                          |
+----------------------------------------------------------+
              | JPA/Hibernate
              ▼
+----------------------------------------------------------+
| Database (PostgreSQL / H2 Demo)                         |
| +---------+ +---------+ +-----------+ +--------+         |
| | Orders  | | Batches | | Inventory | | Audit  |         |
| +---------+ +---------+ +-----------+ +--------+         |
+----------------------------------------------------------+
```

4.2 Technology Stack

Layer	Technology	Version
Frontend	Angular	17.x
Frontend HTTP	Angular HttpClient	17.x
Frontend Rx	RxJS	7.8.0
Backend	Spring Boot	3.2.x
Backend Language	Java	17
Security	JWT (JJWT)	0.12.3
ORM	Hibernate/JPA	6.x
Database (Prod)	PostgreSQL	14+
Database (Demo)	H2	2.x
Build	Gradle	8.5
Testing	JUnit 5 / Jasmine	-
E2E Testing	Playwright	-

5. POC Screens

5.1 Login Screen

- Email/password authentication
- JWT token generation
- Redirect to Dashboard on success

5.2 Dashboard Screen

- Operations status summary (Ready, In Progress, Confirmed)
- Key metrics (Orders, Today's Production, Active Batches)
- Orders ready for production table

- Recent confirmations activity

- Recent batches table

- Quick actions navigation

5.3 Orders Screen

- List all orders with status filtering

- Order detail with line items

- Operations timeline per order

- Status: DRAFT, PENDING, IN_PROGRESS, COMPLETED, CANCELLED

5.4 Production Confirmation Screen

- Order/operation selection

- Input material selection (available inventory/batches)

- Process parameter entry

- Equipment and operator selection

- Output quantity entry

- Batch number preview

- Confirmation submission

5.5 Batches Screen

- List all batches with status filtering

- Batch detail with genealogy

- Forward/backward traceability

- Split and merge operations

- Batch approval workflow

6. Data Model Summary

6.1 Core Entities

Entity	Purpose	Key Fields
User	Authentication	email, password, role
Order	Customer orders	orderNumber, status, customerName
OrderLineItem	Products in order	productSku, quantity, status
Process	Production stage	name, sequence, operationType
Operation	Process step	name, status, sequence
ProductionConfirmation	Production record	quantities, times, parameters
Inventory	Material tracking	materialId, quantity, state
Batch	Trackable unit	batchNumber, quantity, status
BatchRelation	Genealogy	parentBatch, childBatch, relationType
Equipment	Machines	name, status, type
Operator	Personnel	name, employeeId

7. Demo Credentials

User	Email	Password	Role
Admin	admin@mes.com	admin123	Admin

8. Demo Scenarios

8.1 Scenario 1: Complete Production Confirmation

1. Login as admin@mes.com

2. Navigate to Orders, select IN_PROGRESS order

3. Navigate to Production Confirmation

4. Select order and READY operation

5. Select input materials (batches)

6. Enter process parameters

7. Enter equipment and operators

8. Enter produced quantity

9. Submit confirmation

10. Verify: New batch created, inventory updated, genealogy linked

8.2 Scenario 2: Batch Traceability

1. Navigate to Batches

2. Select a finished good batch

3. View genealogy

4. Trace backward to raw materials

5. Verify complete chain of custody

9. Success Metrics

Metric	Target	Measurement
Feature Completeness	90%+	Implemented vs specified features
Test Coverage	80%+	Unit + integration tests
UI Responsiveness	<2s	Page load times
Data Integrity	100%	Batch genealogy accuracy

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