

Rayterton Manufacturing Execution System (MES)

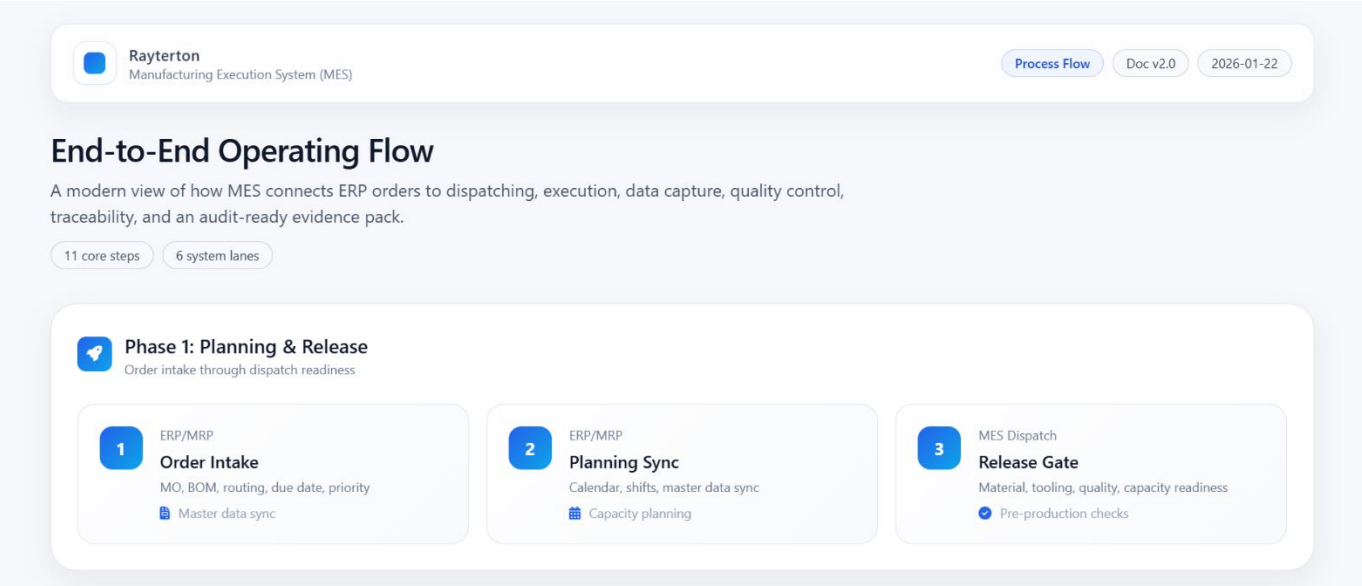
Control production execution from order release to full audit pack, with real time signals, closed loop quality, and multi plant visibility.

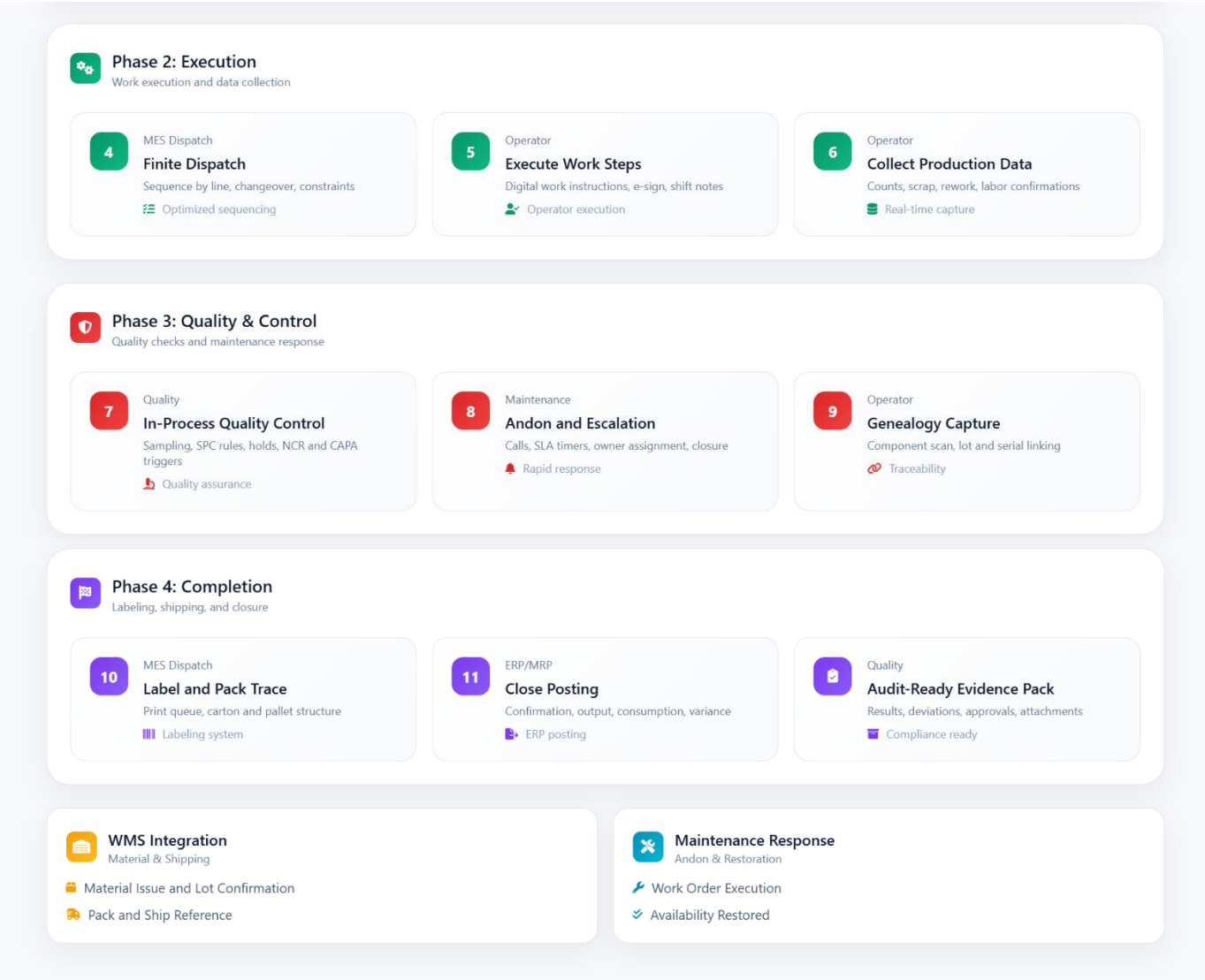
End to End Shop Floor Control

Rayterton Manufacturing Execution System (MES) streamlines manufacturing operations, from order dispatching to work center loading, quality checks, and real-time traceability across 3 plants, 12 lines, and 58 work centers. Our system integrates seamlessly with ERP/MRP, PLCs, IoT, QMS, and WMS for optimal efficiency.

End to End Operating Flow

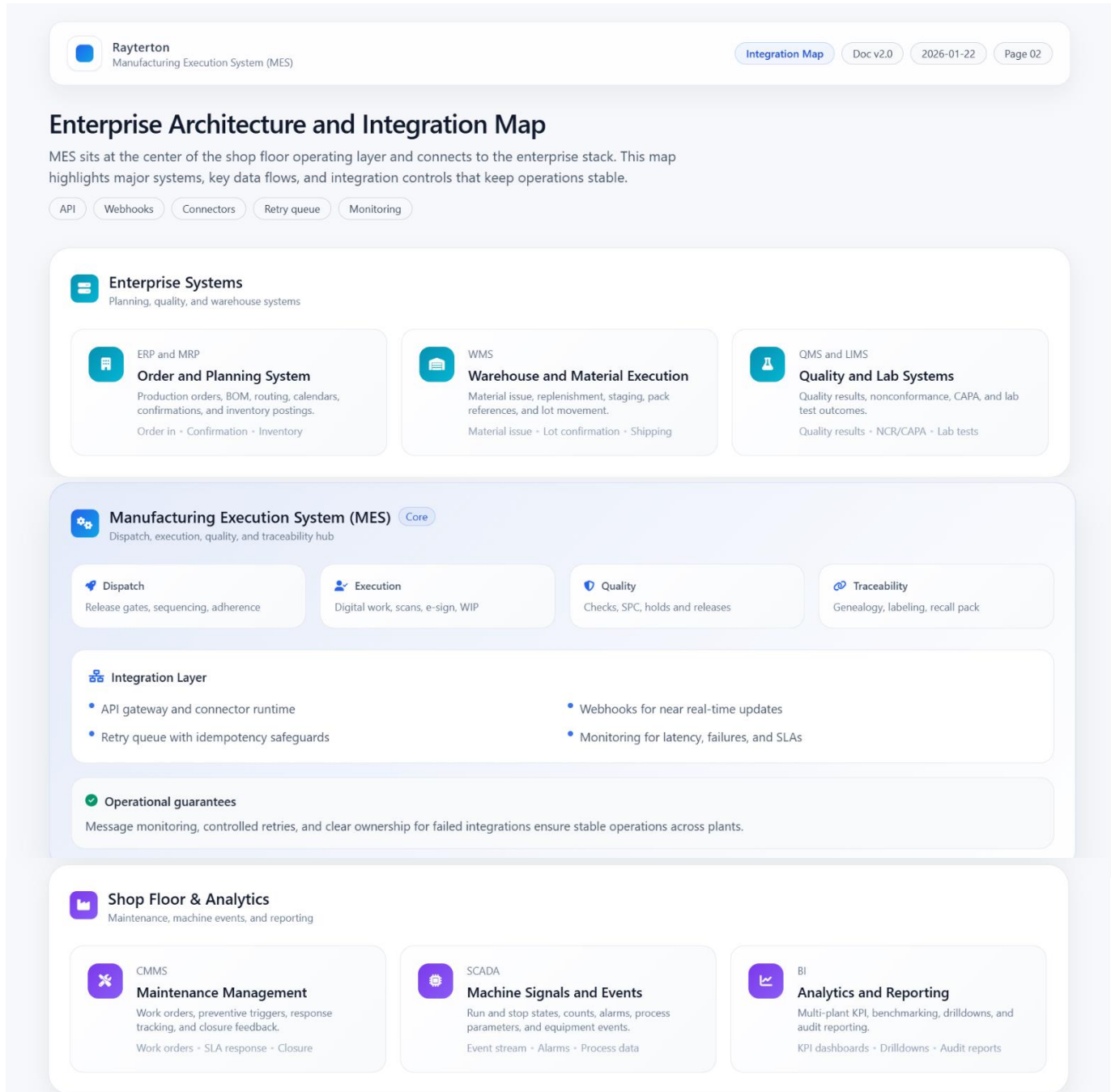
Operating flow starts when ERP sends production orders. MES applies release gate checks, dispatches work to lines, guides operators with digital work instructions, records production and quality results, triggers Andon, maintains genealogy, prints compliance labels, closes the order, then publishes performance analytics and audit packs.





Enterprise Architecture and Integration Map

Rayterton **MES** is designed as part of an enterprise stack, not a standalone app. MES sits in the middle and exchanges structured data with **ERP** or **MRP**, **WMS**, **QMS**, **LIMS**, **CMMS**, **SCADA**, and **BI**. Key integration patterns include APIs, webhooks, and connectors with monitoring, retry queue, and safe reprocess. Data flows cover order in, confirmations out, inventory postings, quality results, maintenance work orders, and event streams from edge gateways.



Key Data Flows

Transactional flows and event streams

→ ERP ↔ MES

- Order in (production orders, BOM, routing)
- Confirmation out (output, consumption, variance)
- Inventory postings (material movements)

→ WMS ↔ MES

- Material issue and lot confirmation
- Shipping trace and pack references

→ QMS/LIMS ↔ MES

- Quality results and lab test outcomes
- NCR and CAPA triggers

→ MES ↔ CMMs

- Work orders and maintenance triggers

→ SCADA ↔ MES

- Event stream (run/stop, counts, alarms)
- Process parameters and equipment events

→ MES ↔ BI

- Analytics feed (KPI dashboards, drilldowns)
- Audit and recall reporting

Note: This map is designed for brochure storytelling. Implementation can use REST APIs, message queues, OPC UA gateways, and warehouse exports based on plant standards.

Rayterton MES | Executive Brochure Mockups

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Production Order Inbox and Release Gate

Orders arrive from **ERP** in an inbox that supports controlled release. The release gate ensures production starts only when prerequisites are met. The release gate checks material readiness, tooling readiness, quality readiness, and capacity readiness. Orders can be approved, kept pending, or blocked with a clear reason. This reduces last minute line stops and prevents execution with missing controls.

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Production Control

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Production Order Inbox and Release Gate

Orders arrive from ERP and stay in the inbox until the release gate confirms readiness. Gate checks are explicit and explainable to prevent avoidable line stoppages.

Operational scale: 3 plants, 12 lines, 58 work centers

Active today: 8 lines

Daily output baseline: 18,600 units

Inbox snapshot

Updated 2 minutes ago. Horizon: next 10 working days.

Filter: All plants

Sort: Due date

View: Orders

Approved

12

Ready to dispatch

Pending

11

Waiting for readiness

Blocked

9

Blocked with explicit reasons

Release governance

Frozen window rule: 8h

Approval required: High priority

SoD check: Passed

Audit trail: Enabled

Release gate (selected order)

Order MD-2401187 | Plant PLT-B | Line LN-04

Aging 3h 12m | Due 2026-01-25

Material ready

All lots reserved

98.5% available

Tooling ready

Service overdue

Tool T-MD-229 locked

Quality ready

First article required

QA sign-off pending

Capacity ready

Shift staffed

utilization 71%

Order inbox

Minimum 30 rows. Mixed due dates, priorities, and statuses across 8 active lines.

Statuses: Pending, Blocked, Approved

Plants: PLT-A, PLT-B, PLT-C

ORDER	PRODUCT	LINE	DUE DATE	PRIORITY	QTY	STATUS	AGING	BLOCK RE
MO-2401174	RMX-200 Valve Body, Rev C	LN-01	2026-01-23	High	1,800	Approved	42m	-
MO-2401176	AXL-410 Gear Housing, Rev A	LN-02	2026-01-23	Medium	2,400	Approved	1h 05m	-
MO-2401179	PCB-780 Controller Board, Lot Build	LN-03	2026-01-24	High	3,000	Approved	33m	-
MO-2401181	FCT-115 Final Assembly Kit	LN-05	2026-01-24	Low	1,200	Approved	2h 11m	-
MO-2401184	RMX-200 Valve Body, Rev C	LN-04	2026-01-25	Medium	1,600	Pending	1h 44m	Waiting for QA first
MO-2401186	AXL-410 Gear Housing, Rev A	LN-06	2026-01-26	Low	2,200	Pending	58m	Material lot reserva
MO-2401188	PCB-780 Controller Board, Lot Build	LN-07	2026-01-27	High	2,800	Pending	2h 05m	Awaiting tooling re:
MO-2401191	FCT-115 Final Assembly Kit	LN-08	2026-01-27	Medium	1,050	Pending	1h 18m	Capacity check runn
MO-2401187	RMX-200 Valve Body, Rev C	LN-04	2026-01-25	High	1,950	Pending	3h 12m	Tool T-MD-229 lock

Dispatch Sequencing Board and Finite Schedule

Dispatch is presented as a line based board with shifts and a 2 day horizon. Sequencing supports setup family grouping, changeover awareness, and constraint badges for material, tooling, quality holds, and planned maintenance. Planners can resequence, freeze a window, and flag expedite jobs while keeping trace of what changed and why.

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Dispatch and Scheduling

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Dispatch Sequencing Board and Finite Schedule

A finite schedule view that shows line-level sequencing across shifts, with setup family grouping, constraint visibility, and actions to resequence, freeze windows, and expedite critical work.

Horizon: 2 days

Lines: 6

Operations: 52

Frozen window: 8h

Changeover families: 5

Schedule controls

Changes inside the frozen window require approval and leave an audit trail.

Resequence

Auto-group by family

Freeze window

Expedite flag

Schedule adherence risk

7

Potential late operations

Changeovers

14

Across 2-day horizon

Constraints active

9

Material, tool, quality, maintenance

Expedites

3

Customer priority

Setup family and changeover

Grouping reduces setup time and stabilizes schedule.

Matrix: active families

FAM-A | Alloy housing

avg 22m

FAM-B | PCB assembly

avg 35m

FAM-C | Final assembly

avg 18m

FAM-D | Molded parts

avg 48m

FAM-E | Heat treat

avg 62m

Constraint badges

Material

Tool

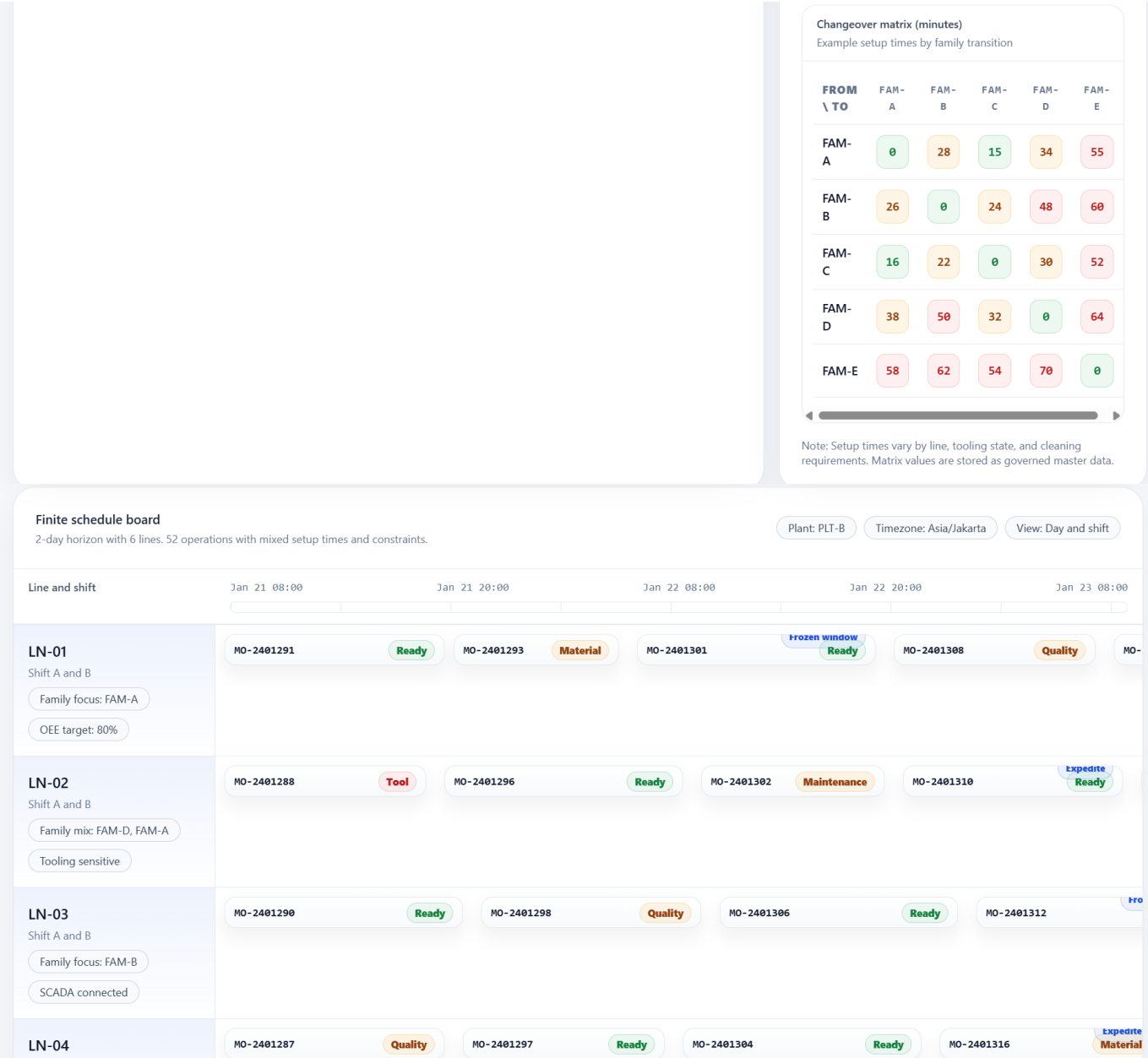
Quality

Maintenance

Ready

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Operator Station and Digital Work Instructions

Operator execution is guided by a task list for the current shift. Each task includes the active step, progress, and required scans so execution stays consistent. Digital work instructions provide clear steps with check points. Scans can be enforced for operator badge, material lot, serial, and tool ID. Actions include start, pause, complete, scrap, rework, and hold. Steps that need supervisor sign off are clearly marked and recorded.

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Operator Execution

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Operator Station Task List and Digital Work Instructions

A paperless operator station that guides execution step-by-step, enforces required scans, and captures production evidence with timestamps and sign-offs.

Station: STN-LN03-OP1

Plant: PLT-B

Line: LN-03

Shift: A (08:00 to 16:00)

Today task list

Sequenced by dispatch. Tasks reflect the finite schedule board.

Queued

6

Ready to start

In progress

1

Current operation

Completed

3

Signed and recorded

Shift progress

Target vs actual

Completed 54% of planned output

Planned 3,200 units | Actual 1,728

Digital work instructions

Active task: MO-2401312 | Operation Op-15 | Work center WC-SMT-07

Revision: WI-SMT-780-RevD

Effective: 2026-01-12

E-sign required

REQUIRED SCANS

Operator badge

Operator ID

OPR-11842 | A. Rahman

Training status

Valid for WI-SMT-780-RevD

Verified

Material lot

Expected lot

LOT-SN63-77182

Check

Validate expiry and storage conditions

Scan required

Serial scan

Scan required

Tool ID

Verified

Task queue

Updated 1 min ago

MO-2401312 | Op-15 SMT Assembly

Product PCB-780 | Family FAM-B | Due 2026-01-22

In progress

Planned 480 units

Actual 262 units

Cycle 58s

Scrap 1.9%

MO-2401306 | Op-10 SMT Placement

Product PCB-780 | Family FAM-B

Queued

MO-2401298 | Op-09 AOI Inspection

Requires QA sampling window

Queued

MO-2401290 | Op-05 Solder Paste Setup

Blocked by tooling verification

Hold

MO-2401286 | Op-03 Line Clearance

Completed with supervisor sign-off

Done

Note: Task visibility is role-based. Every start, pause, completion, and exception is timestamped and recorded.

Serial range

SN-780-26-01021 to 01080

Rule

Reject duplicates and out-of-range serials

Tool

T-SMT-N02-044

Calibration

Valid until 2026-03-10

EXECUTION ACTIONS

Start Pause Complete Scrap Rework Hold

Actions require a reason code when applicable. Scrap and rework capture quantity, cause, and disposition.

WORK INSTRUCTION STEPS (10 STEPS)

Step 1. Line clearance and area check

Remove previous labels, confirm bins empty, confirm ESD setup.

Done

Step 2. Verify work order and revision

Confirm order, product revision, and effective work instruction.

Done

Step 3. Material lot scan and validation

Scan solder paste lot and validate expiry and storage conditions.

Active

Required scan: Material lot

Rule: expiry check

Evidence: scan log


Step 4. Load program and verify feeder map

Load program PRG-780-D and verify feeder mapping checklist.

Queued

eSign, Shift Handover, and Exceptions Log

Rayterton **MES** is audit ready because approvals are structured and traceable. Electronic signatures capture who approved, when, and the reason, with the exact scope and context. Shift handover logs record issues, follow up, and next actions. Exceptions capture deviations, rework loops, and hold releases. This keeps operations aligned across shifts and makes investigations faster.



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Audit and e-Sign

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e-Sign, Shift Handover, and Exceptions Log

A controlled record of approvals, shift-to-shift handover, and production exceptions. Every decision is attributable to a person, a timestamp, and a reason, with traceable follow-up actions.

Plant: PLT-B

Line: LN-03

Shift: A to B handover

Timezone: Asia/Jakarta

e-sign approval panel

Shows who approved, when, and why. Supports maker-checker and audit trail.

View audit trail

Request e-sign

PENDING E-SIGN REQUEST

Waiting approval

Hold release approval for MO-2401290 | Operation Op-05

Hold reason: Tool verification incomplete. Release requires supervisor review and QA acknowledgement.

Requestor

Operator | OPR-11842

Requested at

2026-01-21 14:18

Required approver

Shift Supervisor

Policy

Maker-checker

Approval decision

Reason required

Approve

Reject

Return for correction

Signature binds the user identity, role, time, and approval scope. Records appear in the audit pack.

Signature binds the user identity, role, time, and approval scope. Records appear in the audit pack.

RECENT COMPLETED E-SIGNS

Recorded

First article approval

Order MO-2401312 | Step 5 | Evidence ID EVI-019382

Approved by

QA Lead | USR-00941

Timestamp

2026-01-21 09:26

Reason: First article meets AOI criteria. Program revision PRG-780-D verified.

Changeover confirmation

Line LN-03 | Family switch FAM-B to FAM-B | Setup checklist CHK-4421

Approved by

Shift Supervisor | USR-00408

Timestamp

2026-01-21 08:12

Reason: Tool and feeder map verified. No open maintenance blocks.

Deviation acceptance

Deviation ID DEV-00319 | Temporary process parameter change for nozzle cleaning interval

Approved by

Plant Manager | USR-00012

Timestamp

2026-01-20 18:44

Reason: Mitigation plan approved. Additional AOI sampling required for the next 2 lots.

Audit readiness snapshot

Operational logs and exceptions with status visibility.

Shift notes

10

Mixed status

Exceptions

3

Deviation, rework loop, hold release

Open follow-ups

4

Requires next action

Evidence records today

126

Scans, checks, sign-offs

AUDIT PACK COMPONENTS

Batch genealogy, e-sign approvals, exception outcomes, shift logs, and time-stamped production evidence.

Genealogy

e-Sign

Exceptions

Handover

Audit trail

Shift handover log (10 notes)

Issues, follow-ups, and next actions for the next shift.

Export

Create note

Timestamp	Line and Order	Issue and Context	Follow-up #
2026-01-21 14:05	LN-03 MO-2401312	AOI false positives increased after nozzle clean. Sampling adjusted to every 30 minutes. <div>QualityManufacturing</div>	QA to review in update checklist Owner: QA Lead
2026-01-21 13:42	LN-02 MO-2401288	Tool verification blocked. Tool ID mismatch with approved setup sheet. <div>RiskManufacturing</div>	Supervisor to verify and request help Owner: Shift Sup 15:00
2026-01-21 12:58	LN-05 MO-2401311	Furnace temperature drift detected. Run continued with temporary monitoring rule. <div>MaintenanceRisk</div>	Maintenance to confirm calibration Owner: Maintenance 22:08:30
2026-01-21 12:15	LN-03 MO-2401298	Rework station queue increased. Defect code D14 trending. <div>Quality</div>	QA to open defect rework loop process Owner: QA Lead
2026-01-21 11:46	LN-01 MO-2401301	Material lot switch performed. Expiry validated and logged in MES. <div>Manufacturing</div>	No follow-up required standard sampling Owner: N/A

Exception log (3 records)

Deviations, rework loops, and hold releases with decision outcomes.

Filter

Create exception

Deviation DEV-00319

Closed

Scope

Temporary parameter change for nozzle cleaning interval

Line and order
LN-03 | MO-2401312

Created at
2026-01-20 17:55

Approved by
Plant Manager | USR-00012

Approval timestamp
2026-01-20 18:44

Reason

Reduce stop events while maintaining AOI sampling. Mitigation includes additional sampling for the next 2 lots.

RiskQuality

Evidence: EVI-019102

Rework loop RWK-00871

Follow-up

Issue

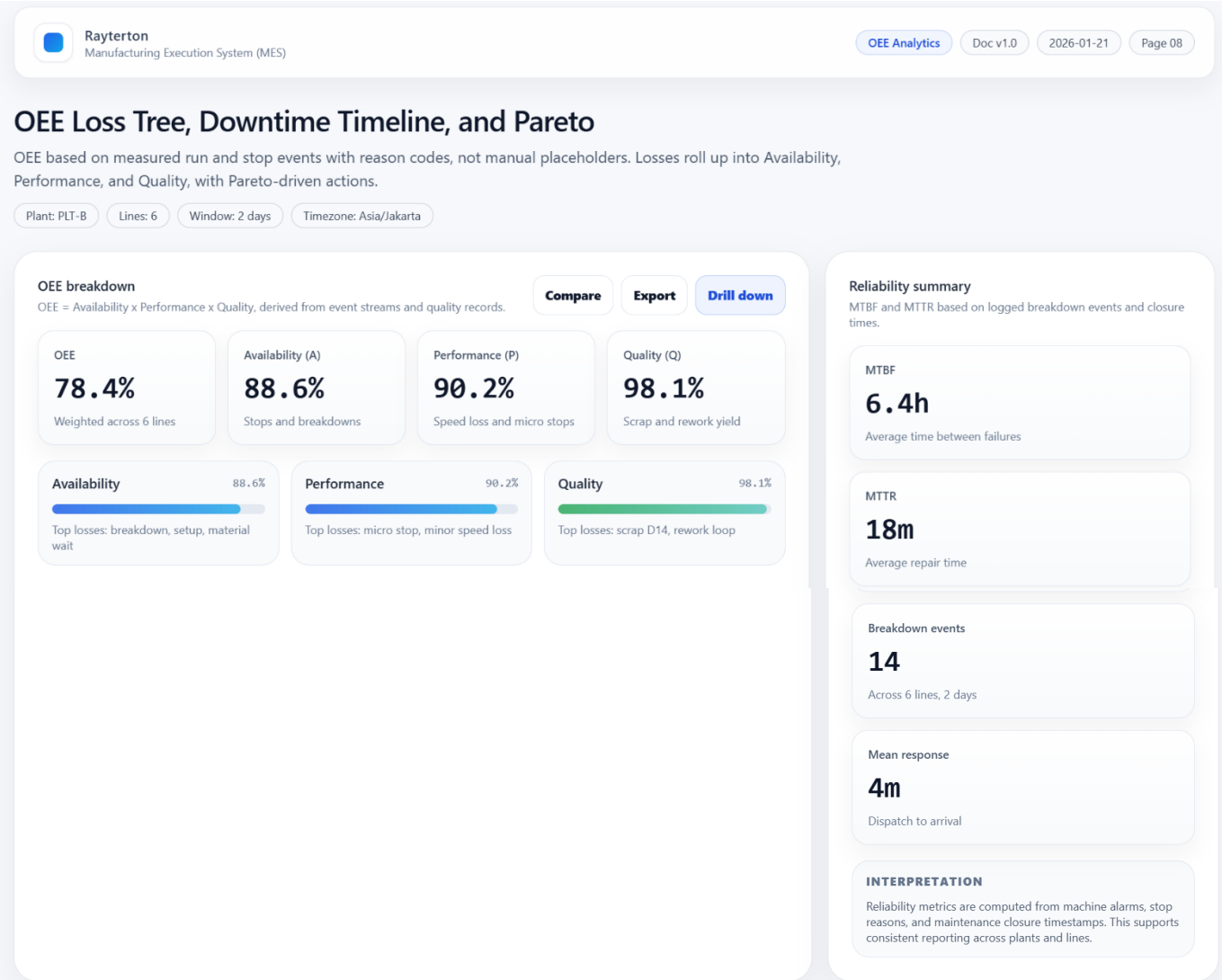
Defect code D14 trending on AOI reroute to rework station

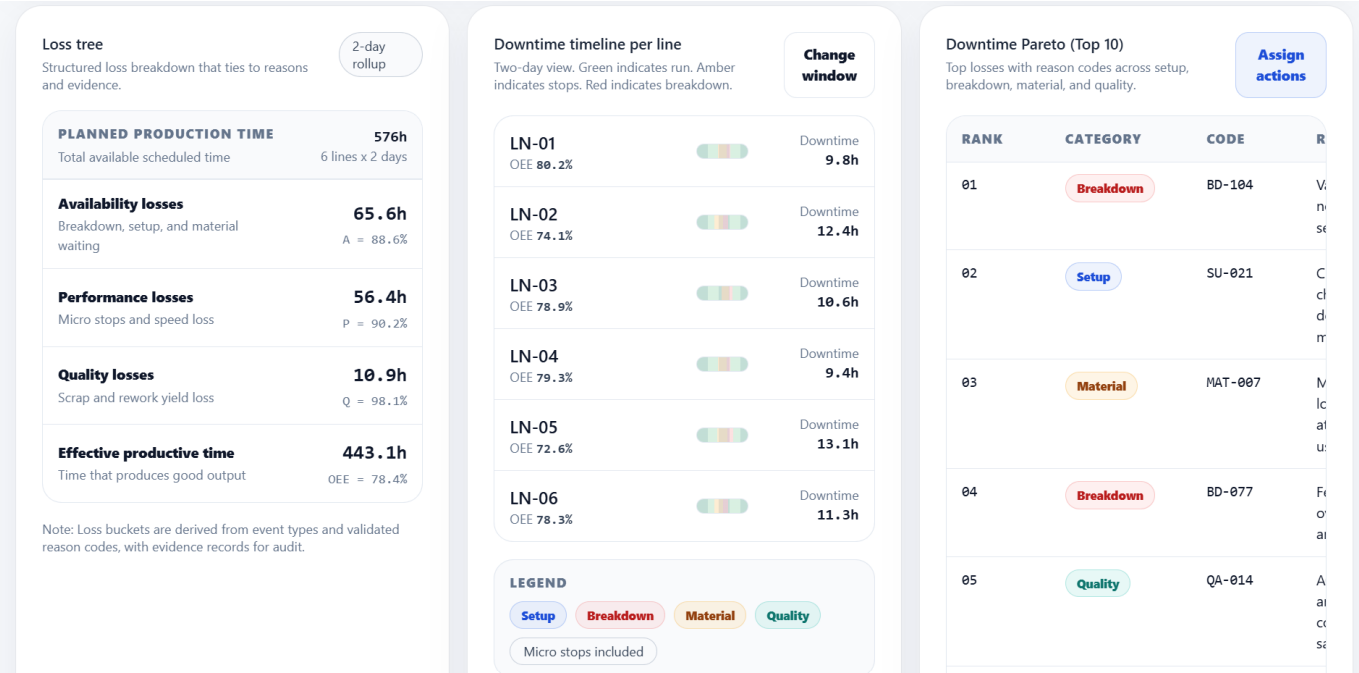
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OEE, Loss Tree, and Downtime Pareto

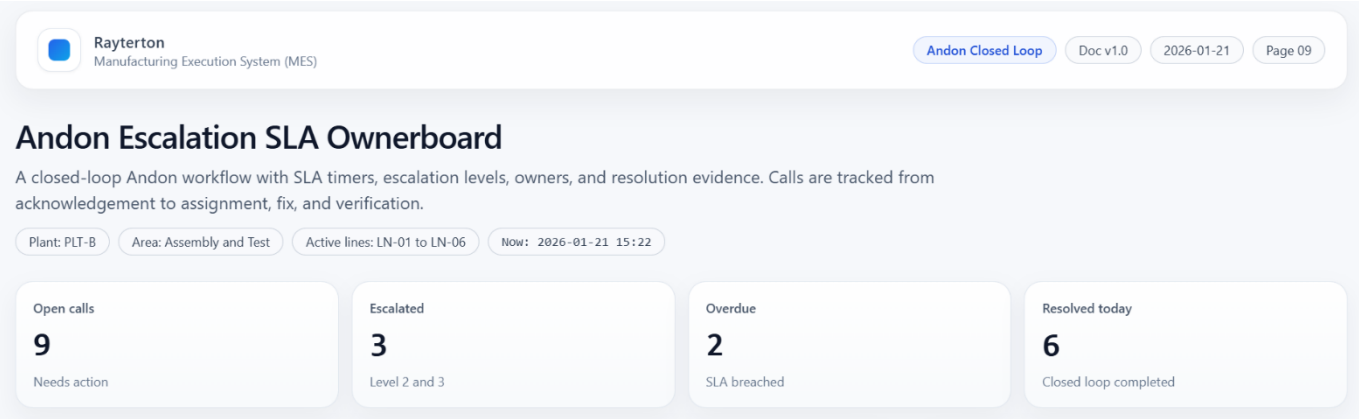
KPI is meaningful only if it can be explained. Rayterton MES breaks OEE into Availability, Performance, and Quality, and links losses to reason codes and events. Downtime timeline shows when stops happen per line. Pareto highlights the top losses and categories such as setup, breakdown, material, and quality. MTBF and MTTR provide a concise reliability view that links back to work centers and events.





Andon Escalation, SLA, and Ownerboard

Calls are tracked with SLA timer, escalation level, owner, and status. Teams can acknowledge, assign, resolve, and add notes. Overdue calls and escalations are visible at a glance so leadership can see response discipline and recurring causes.



Andon calls (15)

Material, quality, maintenance, and safety calls with SLA timers and escalations.

Filter

Sort

Create call

CALL	CATEGORY	LINE	ISSUE	SLA TIMER	ESCALATION	OVERVIEW
AND-220401	Material	LN-03	Resistor R-Pack 10k below min, feeder starving, kitting required	+18m overdue Target: 10m Open: 15:10	Level 3	W
AND-220398	Maintenance	LN-02	Pick-and-place feeder jam, micro stops spiking, needs technician intervention	4m left Target: 20m Open: 14:58	Level 2	M
AND-220392	Quality	LN-05	Label verification mismatch, print head cleaned and label rule updated variance, requires calibration check	Resolved Target: 15m Closed: 14:41	Level 1	Q
AND-220360	Material	LN-02	IC U12 near min, call placed to supermarket, pick list created	9m left Target: 20m Open: 15:11	Level 1	M
AND-220354	Safety	LN-06	Spill near packing station, clean-up and verification required	Resolved Target: 10m Closed: 14:22	Level 1	H
AND-220349	Quality	LN-03	First article check pending after changeover, supervisor sign required	5m left Target: 20m Open: 15:07	Level 2	S
AND-220331	Maintenance	LN-05	Printer head wear	16m left Target: 60m Open:	Level 1	M

Escalation policy

How calls escalate when SLA is at risk or breached.

Edit

SLA TARGETS

Material	10m	Quality	30m
Maintenance	20m	Safety	20m

ESCALATION LEVELS

Level 1

Line owner

Level 2

Shift supervisor

Level 3

Plant duty manager

Escalation triggers at 70% of SLA for Level 2, and at SLA breach for Level 3, with notifications and audit trail.

Selected call details

Closed-loop record with notes and timestamps.

Open full record

CALL

AND-220401

Category Material | Line LN-03 | Escalation Level 3

TIMELINE

Opened	15:10
Escalated to L2	15:17
Escalated to L3	15:20
SLA target	10m
Current breach	+18m

NOTES

Consumption spike detected after resequence on LN-03. Supermarket bin empty. Pick list PICK-22031 created. Expedite requested. Temporary substitution not allowed due to controlled spec.

Pick: PICK-22031

eKanban: CALL-77102

Evidence required


ACTIONS

Acknowledge

Assign

In Process Quality Checks, Sampling, Hold, and Release

Sampling schedules and check sheets guide what to measure and when. Results are captured as pass or fail with comments and evidence attachments when needed. A failed check can trigger a hold. Hold release is governed and traceable, and NCR can be created directly from the check outcome.



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In-Process Quality
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In-Process Quality Checks, Sampling, Hold, Release

Quality runs during production with a sampling schedule, check sheets, measured results, and evidence attachments. Failed checks can trigger a controlled hold, with release and NCR creation governed by approvals.

Plant: PLT-B
Line: LN-03
Order: MO-2401312
Product: PCB-780
Shift: A

Checks today
20
In-process sampling

Pass
18
Within spec

Fail
2
Triggered hold

Active holds
2
Awaiting disposition

Sampling schedule and check records (20)

Each record links measured results, comments, and evidence attachments.

SAMPLING PLAN
Every 30 minutes
First article at start, then periodic checks per lot window.
Plan: SP-30M Spec rev: R7

CHECKS IN SHIFT
08:00 to 16:00
Expected 16 checks, plus event-based checks after changeover.
Line: LN-03
Last check: 15:05

RULES
Fail triggers hold
Hold scope can be unit, lot, or time window depending on severity.
Evidence required Audit trail

CHECK	TIME	SCOPE	CHARACTERISTIC	SPEC
IPQC-12001	08:12	First article	Paste height	0.16 to 0.22 mm
IPQC-12002	08:42	Periodic	AOI defects	0 major, 0 critical
IPQC-12003	09:10	Periodic	Reflow peak temp	238 to 245 C
IPQC-12004	09:42	Periodic	Label scan match	Match required
IPQC-12005	10:12	Periodic	Torque screw M2	0.35 to 0.45 Nm

Check sheet form

Record measured results with pass fail and evidence.

CHECK ID
IPQC-12015
Auto-numbered per line

TIME
2026-01-21 15:05
Shift A

CHARACTERISTIC
Paste height
CTQ


SCOPE
Periodic
Every 30 minutes


SPEC
0.16 to 0.22 mm
Spec rev R7

MEASURED
0.23 mm
Gauge ID G-0091

RESULT
Fail Out of spec
Comment: High paste height. Suspected stencil wear. Stopped and cleaned. Hold items in affected window.

EVIDENCE ATTACHMENTS

 Stencil photo
EVI-33058-01.jpg Open

 Gauge reading Open

IPQC-12009	12:18	Periodic	Reflow peak temp	238 to 245 C
IPQC-12010	12:46	Periodic	Paste height	0.16 to 0.22 mm
IPQC-12011	13:12	Periodic	Torque screw M2	0.35 to 0.45 Nm
IPQC-12012	13:42	Periodic	Reflow peak temp	238 to 245 C
IPQC-12013	14:10	Periodic	AOI defects	0 major, 0 critical
IPQC-12014	14:40	Periodic	Label scan match	Match required
IPQC-12015	15:05	Periodic	Paste height	0.16 to 0.22 mm
IPQC-12016	15:18	Event-based	Post-clean verification	All CTQ pass

Hold and release board

Two holds are active from failed checks.

Open queue

HOLD-77120

Trigger: IPQC-12012 | Reflow peak temp above spec

Hold

SCOPE AND QUANTITY

Scope: Time window 13:30 to 13:52 | Affected: 18 units | WIP ID WIP-0198740

Disposition pending. Engineering review required.

Severity: MajorOwner: USR-00408

Evidence: EVI-33049

Create NCRAdd noteRelease

HOLD-77128

Trigger: IPQC-12015 | Paste height above spec

Under review

SCOPE AND QUANTITY

Scope: Lot window FG-LOT-780-21A | Affected: 12 units | Station STN-Paste-01

Containment applied. Awaiting QA sign-off after verification check.

SPC Control Chart, Rule Violations, and Action Log

Control charts show limits, data points, and rule violations such as trends, beyond limit, and run rules. Violations are listed with details, affected time window, and impact scope. An action log connects the violation to a corrective adjustment or to NCR and CAPA when the issue indicates systemic risk.

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SPC Actionable Quality

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SPC Control Chart, Rule Violations, Action Log

Control charts become actionable when rule violations create owners, due dates, evidence, and corrective actions. Each violation can link to an adjustment record or NCR to close the loop.

Plant: PLT-BLine: LN-03Station: STN-Paste-01Metric: Paste heightNow: 2026-01-21 15:28

Points

30

Last 2 hours

Violations

2

1 beyond limit, 1 trend

Open actions

1

Corrective action created

Limits

UCL 0.22

CL 0.19 | LCL 0.16 (mm)

X chart (individual points)

UCL, CL, LCL with highlighted rule violations and linked actions.

Time range

Subgroup

Rules

Unit: mm Sampling: every 4 minutes Mean: 0.190 Sigma: 0.010

Limits Normal Trend rule Beyond limit



RULES ENABLED

Beyond limit On
Trend (7 increasing) On
Run (8 same side) On

LATEST POINT

0.193 mm
Within limits. No rule triggered.
Point #30 at 15:28

LINKAGE

Violations can create a hold, adjustment, or NCR. Actions remain open until verified with evidence.

Create NCR

Create adjustment

Assign owner

Note: 30 points are shown. Two rule violations are flagged and tied to actions.

Rule violations (2)

Trend and beyond limit violations with ownership and SLA.

Acknowledge

VIO-88021

Open

Type: Beyond UCL | Point #18 | Value 0.225

OWNER

QA QA Inspector
USR-01102

Detected: 14:52

SLA: 30m

Evidence required

Create adjustment

Create NCR

Add note

VIO-88019

Acknowledged

Type: Trend rule | Points #6 to #12 | Increasing sequence

OWNER

SV Shift Supervisor
USR-00711

Detected: 14:34

Monitor and verify

Add note

Mark verified

Action log

Actions created from SPC violations, with links to NCR or adjustments.

Open history

TIME	ACTION	TR
14:54	ADJ-44102	VI
14:56	HOLD-77133	VI

NCR and CAPA Workflow with Root Cause and Verification

NCR records include severity, source, line, product, and status. CAPA breaks down tasks into root cause, action plan, owner, due date, evidence, and verification. Approvals and audit trail keep the workflow controlled. Verified closure means the fix was validated, not only completed.

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NCR and CAPA Governance

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NCR CAPA Workflow, Root Cause, Verification

A governed problem-solving workflow that connects nonconformances to root cause, corrective and preventive actions, verification evidence, and audit-ready approvals.

Plant: PLT-B

Week: W04

Open NCR: 4

Active CAPA: 5

Now: 2026-01-21 15:36

NCR total

10

This week

Open

3

Needs action

In progress

4

Root cause and CAPA running

Verified

3

Effectiveness confirmed

NCR register (10)

Severity, source, line, product, and status. Each NCR links to CAPA and audit trail.

Filter

Export

Create NCR

NCR	SEVERITY	SOURCE	LINE	PRODUCT
NCR-54011	Major	SPC rule	LN-03	PCB-780
NCR-54008	Critical	In-process QC	LN-04	PCB-820
NCR-54005	Minor	Operator	LN-02	PCB-780
NCR-54003	Major	AOI	LN-05	PCB-910
NCR-54002	Minor	Incoming QC	LN-01	IC-U12
NCR-53998	Major	Maintenance	LN-06	PCB-820
NCR-53995	Critical	Customer complaint	LN-03	PCB-780

CAPA tasks (5 active)

Owners, due dates, evidence, and verification status.

Create CAPA

CAPA-22091

Linked NCR: NCR-54011

OWNER

Process Engineer

USR-01210

DUE DATE

2026-01-22 12:00

Priority: High

EVIDENCE

LOG

Stencil pressure change record

EVI-44102-01.csv

Open

IMG

Stencil inspection photos

EVI-44102-02.zip

Open

Add note

Request verification

Escalate

CAPA-22088

Linked NCR: NCR-54008

Open

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Critical

Customer complaints

Minor

In-process QC

LN-06

PCB-910

Minor

SPC rule

LN-02

PCB-780

Minor

Operator

LN-01

PCB-820

Note: NCRs can originate from SPC, in-process checks, equipment events, or customer complaints. Each NCR can block shipment and is linked to CAPA and evidence.

CAPA-22088

Linked NCR: NCR-54008

Open

OWNER

Quality Manager

USR-00408

DUE DATE

2026-01-22 10:00

Priority: Critical

Root cause required. Containment hold active and shipment block applied until verification passes.

Start RCA

Create containment

Add note

CAPA-22084

Linked NCR: NCR-54003

In progress

OWNER

AOI Engineer

USR-00811

DUE DATE

2026-01-23 17:00

Priority: Medium

Threshold adjustment and re-validation planned. Evidence must include golden board results and before/after metrics.

Attach evidence

Request verification

CAPA-22079

Linked NCR: NCR-53998

In progress

Electronic Batch Record, Review Pack, and Final Approval

The record summarizes material lots, process parameters, and sign offs per step. Deviations and holds are summarized with closure status. Attachments and review checklist form a review pack for final approval. This supports compliance, customer audits, and internal governance.

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Electronic Batch Record (eBR)

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Electronic Batch Record, Review Pack, Final Approval

Audit-ready batch records consolidate material lots, critical parameters, operator entries, and controlled sign-offs. Deviations and holds are summarized with closure evidence before final QA approval.

Plant: PLT-B

Line: LN-04

Product: PCB-820

Batch: BATCH-820-26W04-011

Order: MO-2401420

Batch steps

12

Full execution trace

Sign-off points

3

e-sign with timestamps

Deviations

1

Closed with evidence

Final status

Ready for QA review

Checklist pending final approval

Batch record summary

Materials, parameters, and sign-offs consolidated in one review view.

Print pack

Export PDF

Open full eBR

PLANNED QTY

1,200 units

Start: 08:10 | End: 15:22

PRODUCED

1,176 units

Yield: 98.0%

SCRAP AND REWORK

Scrap 12 | Rework 8

All linked to genealogy

MATERIAL LOTS USED

MATERIAL	LOT	QTY	IQC
Solder paste SP-93	LOT-SP93-260121A	3.6 kg	● Accepted
PCB base board BB-820	LOT-BB820-260119C	1,220 pcs	● Accepted
IC U12	LOT-U12-260118B	1,260 pcs	● Accepted
Connector CN-14	LOT-CN14-260120A	1,240 pcs	● Accepted

CRITICAL PARAMETERS SNAPSHOT

PARAMETER	SPEC	OBSERVED	STATUS
Paste height	0.16 to 0.22 mm	Mean 0.190	● Within
Reflow peak temp	238 to 245 C	241 C	● Within
AOI major defects	0 allowed	0	● Within
Torque M2	0.35 to 0.45 Nm	0.41 Nm	● Within

Parameters link to SPC charts and calibration records where required.

Batch steps (12) with sign-offs

Each step includes timestamps, operator identity, and evidence.

Expand all

Jump to deviation

1. Batch initiation and line clearance

Line LN-04 cleared, previous labels removed, station checks complete

Operator USR-01910 | Start 08:10 | Evidence EVI-EBR-001

Complete
2. Material issue and lot scan

Scan and confirm lots for paste, PCB boards, and critical components

Material lots captured and reconciled to WIP consumption. WMS ref GI-78110.

Complete
3. Setup verification and first article

First article inspection required before run release

OP Operator sign

USR-01910 | 08:22

QA QA sign

USR-01102 | 08:34

Signed
4. Execute run, capture parameters

Deviations and holds summary

One deviation closed. No active holds remaining for this batch.

Open log

Deviation DEV-33019

Micro stop event, sensor adjustment, verification passed

Closed

DISPOSITION

Continue with corrective maintenance

CMMS WO-77102

VERIFICATION

Passed

12:44

Evidence includes equipment check, event timeline snapshot, and maintenance completion note.

Evidence: EVI-DEV-33019

Linked CAPA: CAPA-22079

HOLDS

0 active holds

Clear

Shipment release is not blocked. Any hold would appear here with scope and release approvals.

Attachments (review pack)

Evidence set required for review and audit trace.

[Download pack](#)

SPC

SPC chart snapshot

EVI-EBR-SPC-011.pdf

[Open](#)

QC

IPQC check sheets

EVI-EBR-IPQC-011.zip

[Open](#)

EVT

Event timeline export

EVI-EBR-EVT-011.csv

[Open](#)

MNT

Maintenance completion note

EVI-EBR-CMMS-011.pdf

[Open](#)

LBL

Label reconciliation report

EVI-EBR-LBL-011.pdf

[Open](#)

Review checklist and final approval

Checklist gates final approval to ensure audit readiness.

[Approve](#)



All material lots scanned and reconciled

No missing lots or mismatch in consumption posting

[Pass](#)



Critical parameters within spec

SPC reviewed and violations addressed

[Pass](#)



Deviations closed with evidence

DEV-33019 closed, verification attached

[Pass](#)



Sign-off points completed

Operator and QA e-sign captured

[Pass](#)



Final QA review and approval

Requires QA manager sign and timestamp

[Pending](#)

Sign-off 1: First article release

QA USR-01102 | 08:34 | Reason: first article passed

[Signed](#)

Sign-off 2: Batch step completion

Supervisor USR-00711 | 12:52 | Reason: deviation closed

[Signed](#)

Sign-off 3: Final QA approval

Pending, checklist must complete before approval

[QA gate](#)

Traceability and Genealogy Explorer

Traceability is a core differentiator. The genealogy view supports backward trace from finished good to component lots, process steps, QC results, operators, and machines. Forward trace identifies where a component lot was consumed and where finished goods were shipped. Filters include date range, lot, serial, and order. Rework loops are visible so investigations are accurate.

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Traceability and Genealogy
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Traceability Genealogy Explorer, Forward and Backward

One-click genealogy shows what went into a unit and where it went next. Each node links to material lots, process steps, QC results, operator identity, and machine context. Rework loops remain visible for audit and containment.

Plant: PLT-B
Line: LN-04
Product: PCB-820
Serial: SN-820-26W04-0110452
Order: MO-2401420

Filters

Refine genealogy by date range, lot, serial, and order.

DATE RANGE
2026-01-21 07:00 to 2026-01-21 16:00
Include upstream lots and downstream shipment

SERIAL
SN-820-26W04-0110452
Finished good unit

ORDER
MO-2401420
Batch BATCH-820-26W04-011

LOT FILTER
LOT-SP93-260121A
Highlight nodes that touched this lot

Backward trace
Forward trace
Containment scope
Export genealogy

Nodes
12
Includes rework loop

Material lots
4
Paste, board, IC, connector

QC checkpoints
3
FAI, IPQC, AOI

Downstream
Shipped
DN-88011 | INV-99102

Genealogy graph (12 nodes)
Select a node to view lots, process context, QC results, operator, and machine details.

Center
Expand
Highlight lot

View: Backward + Forward
Rework loop: visible
Node IDs: enabled

Lot
QC
Machine
Operator

Node details

Open record

A focused summary of the selected node.

AOI Inspection
Rework loop

STEP-08 | 13:10

QC RESULT
1 false reject, rework executed, re-inspected pass
QC-RES-88014

MACHINE
AOI-02 | CAM-FW 3.2
Calibration: CAL-77110 (valid)

OPERATOR
QA Inspector
USR-01102

LINKED ACTIONS

SELECTED FINISHED GOOD

SN-820-26W04-0110452

Status: Shipped. Genealogy includes one rework loop after AOI.

Pack: PK-22019

Shipment: DN-88011

CONTAINMENT SCOPE

Use lot filter or process window to find all impacted serials and shipments, then create hold and recall scope if required.

Create hold

Recall scope

TRACE LINKS

LotsStepsQC

OperatorsMachines

Every node is clickable and carries audit metadata.

Note: Nodes include materials, process steps, QC results, rework loop, pack, and shipment. All events are timestamped and link to audit logs.

LINKED ACTIONS

RMK-11021 | NOTE-91018

No shipment block

View QC evidenceView audit trail

Trace tables

Lots, steps, operators, and machines involved.

Export

MATERIAL LOTS

MATERIAL	LOT
Solder paste SP-93	LOT-SP93-26012
PCB base board BB-820	LOT-BB820-2601
IC U12	LOT-U12-260118
Connector CN-14	LOT-CN14-26012

Lot clicks highlight related nodes and downstream shipments.

PROCESS STEPS AND CHECKPOINTS

STEP	NAME
STEP-03	First Article Inspection
STEP-05	Reflow Profile
STEP-08	AOI Inspection
STEP-09	Rework Station

Rework loop is preserved and does not hide original inspection failure context.

FORWARD TRACE (SHIPMENT)

PACK	DELIVERY
PK-22019	DN-88011

Shipment links to WMS postings and customer trace scope.

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Materials eKanban, Supermarket Call Queue, and Shortage Handling

Material readiness is managed proactively to prevent line stops. eKanban cards track min, max, and current stock, plus ETA replenishment. A call queue connects material requests to pick references and execution status. Shortage alerts include the reason and resolution note, so the system remains auditable and repeatable.

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Materials eKanban and Supermarket
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Materials eKanban Supermarket, Call Queue, Shortage Resolution

Supermarket-driven replenishment reduces line stops by making material readiness visible. Kanban cards track min max, current stock, and ETA replenishment. Call queue provides pick references and execution status. Shortages trigger alerts with resolution notes and audit trail.

Plant: PLT-B
Supermarket: SMK-04
Lines served: LN-03, LN-04, LN-05
Now: 2026-01-21 15:36

Items monitored
20
Supermarket cards

Active calls
6
Pick in progress

Shortage alerts
2
Requires resolution note

Line stop risk
Managed
ETAs and escalation active

eKanban cards (20 items)
Min max, current, and ETA replenishment per item. Low stock triggers auto call.

Filter Sort Create call

Solder paste SP-93 ● Shortage
MAT-SP93
LN-04
Bin: SMK-04-A03
ETA: 16:02

PCB base board BB-820 ● Call active
MAT-BB820
LN-04
Bin: SMK-04-A07

IC U12 ● Shortage
MAT-U12
LN-05
Bin: SMK-04-B12
ETA: 16:10
Min 240 pcs Max 1400 pcs

Connector CN-14 ● Call active
MAT-CN14
LN-03
Bin: SMK-04-B04
ETA: 15:54

Stencil wipe roll WR-02 ● Call active
MAT-WR02
LN-03
Bin: SMK-04-D02
ETA: 16:06
Min 4 roll Max 20 roll
Current 6 roll Buffer 2.0 roll
Auto call created from min threshold. Pick reference in WMS. ETA based on task route.

ESD glove pack G-10 ● Stable
MAT-G10
LN-05
Bin: SMK-04-D10
ETA: 15:49
Min 6 pack Max 30 pack
Current 12 pack Buffer 6.0 pack
Stable. Next replenishment scheduled by consumption trend and shift window.

Nozzle set NZ-05 ● Call active
MAT-NZ05
LN-04
Bin: SMK-04-A12
ETA: 16:18
Min 2 set Max 10 set
Current 3 set Buffer 1.0 set
Auto call created from min threshold. Pick reference in WMS. ETA based on task route.

Flux FL-22 ● Stable
MAT-FL22
LN-03
Bin: SMK-04-A06
ETA: 16:24
Min 0.8 L Max 3.5 L
Current 1.4 L Buffer 0.6 L
Stable. Next replenishment scheduled by consumption trend and shift window.

Call queue (6 active)
Each call includes pick reference, destination, and status.

CALL	ITEM	LINE
CALL-77102	Solder paste SP-93	LN-04
CALL-77103	Connector CN-14	LN-03
CALL-77104	IC U12	LN-05

Shortage alerts (2)
Shortages require a resolution note and cause classification.

SHORT-11021 | IC U12 supply gap ● Shortage
Line LN-05 | Required 320 pcs | Available 140 pcs
Risk of line stop in 28 minutes. Next replenishment ETA is outside the current takt window.
Bin: SMK-04-B12 ETA: 16:10 PO: PO-55102

SHORT-11022 | Solder paste SP-93 ● Shortage low
Line LN-04 | Required 1.5 kg | Available 0.6 kg
Paste below min threshold. Risk increases during changeover window. Material call created, awaiting delivery


RESOLUTION NOTE
Substituted from buffer lot LOT-U12-2601188 and executed expedited pick. Added supplier follow-up for late delivery window.
Owner: USR-00601 | 15:34

Create expedite Assign owner

Audit trail

Labeling, Pack, Pallet, Serialization, and Print Queue

Shipping compliance requires controlled labeling and serialization. Label templates are versioned and linked to customer requirements. The pack and pallet structure connects units to cartons and cartons to pallets with SSCC. Print queue shows jobs, printers, quantities, and status, linked to shipment or staging. Serial ranges are clear and traceable across the hierarchy.

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Labeling and SerializationDoc v1.02026-01-21Page 16

Labeling, Pack and Pallet Structure, Serialization, Print Queue

Customer compliance labeling is controlled through templates, print governance, and full trace to shipment and staging. Units roll up to cartons, cartons roll up to pallets, and pallets carry SSCC for end-to-end shipping traceability.

Plant: PLT-BStaging: STG-DOCK-02Shipment: DN-88011WMS Wave: WV-22018

Pallets
3
SSCC labeled

Cartons
24
Carton label applied


Units
480
Serialized units

Serial range
SN-820-26W04-0111201 to 0111680
Bound to cartons and pallets


Label templates
Controlled templates for unit, carton, and pallet labeling with customer and compliance fields.

Template libraryField mappingPreview print


Unit label
TPL-UNIT-820 v31D + QR

PCB-820
Model: 820-A | Rev: R2
| Plant: PLT-B
Serial: SN-820-26W04-0110452

GTIN: 08912345678901 | Lot: LOT-BB820-260119C

Carton label
TPL-CTN-820 v2Carton ID

Carton CTN-820-011-03
Qty: 20 units |
Customer: Customer A
Pack: PK-22019 |
DN: DN-88011

Serials: 0111241 to 0111260

Pallet label (SSCC)
TPL-PLT-SSCC v5SSCC

Pallet PLT-011-A
24 cartons total |
Gross: 320 kg
SSCC: 003899999991234567

DN: DN-88011 | Staging: STG-DOCK-02

COMPLIANCE CONTROLS
Templates are versioned, approved, and locked per customer. Print actions record who, when, printer, and reason for reprint. Shipment links validate that the correct label set is used for the destination and customer.

Template approvals enabledReprint requires reasonAudit trail export

Pack and pallet structure
3 pallets, 24 cartons, 480 units. Full roll-up to SSCC and shipment.

Open genealogy

SHIPMENT ROLL-UP

Shipment DN-88011
Customer A | Jakarta | Staging
STG-DOCK-02

Staging

Pallet PLT-011-A
SSCC 003899999991234567
Cartons: CTN 01 to 08 | Units: 160
Serials: 0111201 to 0111360

Pallet PLT-011-B
SSCC 003899999991234568
Cartons: CTN 09 to 16 | Units: 160
Serials: 0111361 to 0111520

Pallet PLT-011-C
SSCC 003899999991234569
Cartons: CTN 17 to 24 | Units: 160
Serials: 0111521 to 0111680

Print queue

Queue by printer, priority, and shipment link. Includes unit, carton, and pallet labels.

Refresh

Pause printer

Release batch

JOB	TYPE	TARGET	TEMPLATE	PRINTER	QTY
PRN-55101	Unit labels	SN 0111201 to 0111400	TPL-UNIT-820 v3	PRN-ZEB-02	200
PRN-55102	Unit labels	SN 0111401 to 0111600	TPL-UNIT-820 v3	PRN-ZEB-02	280
PRN-55103	Carton labels	CTN 01 to 12	TPL-CTN-820 v2	PRN-ZEB-03	12
PRN-55104	Carton labels	CTN 13 to 24	TPL-CTN-820 v2	PRN-ZEB-03	12
PRN-55105	Pallet SSCC	PLT-011-A	TPL-PLT-SSCC v5	PRN-ZEB-04	1
PRN-55106	Pallet SSCC	PLT-011-B	TPL-PLT-SSCC v5	PRN-ZEB-04	1
PRN-55107	Pallet SSCC	PLT-011-C	TPL-PLT-SSCC v5	PRN-ZEB-04	1

PRINT GOVERNANCE

SERIALIZATION BINDING

Unit serials are bound to carton IDs at packing, then cartons are bound to pallet SSCC at palletization. Any rework or replacement serial triggers reconciliation before shipment release.

Scan carton

Scan pallet SSCC

Reconcile mismatch

Shipment and staging link

Connect labeling to WMS staging, dock appointment, and release controls.

Open staging map

DOCK AND STAGING

STG-DOCK-02 | Door 2 | Wave WV-22018

Staging status updates from WMS and scan confirmations

CUSTOMER COMPLIANCE

Label set locked to Customer A profile

Carton and pallet labels must match destination rules

RELEASE GATE

All labels printed, scans verified, pack complete

Blocks shipment if any SSCC mismatch or missing carton label

Integration Monitor, Retry Queue, and Error Handling

Message monitor tracks ERP orders, confirmations, and inventory postings. Latency, success rate, and failed messages are visible with correlation IDs and reason classes. Retry queue supports safe reprocess with idempotency and guardrails. Example operational scale is 2,400 messages per day with 0.7% failed and 12 items in retry queue.

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Integration Operations

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Integration Monitor, Retry Queue, Error Handling

Integration does not stop at a one-time setup. This monitor provides message-level visibility, latency and success tracking, and safe retry handling with controlled reprocess actions. Failed messages are isolated with reasons, payload references, and audit trail.

Flows: ERP Orders, Confirmations, Inventory Postings

Daily volume: 2,400

Failed: 0.7%

Retry queue: 12

Messages today

2,400

All integration channels

Success rate

99.3%

End-to-end ACK received

P95 latency

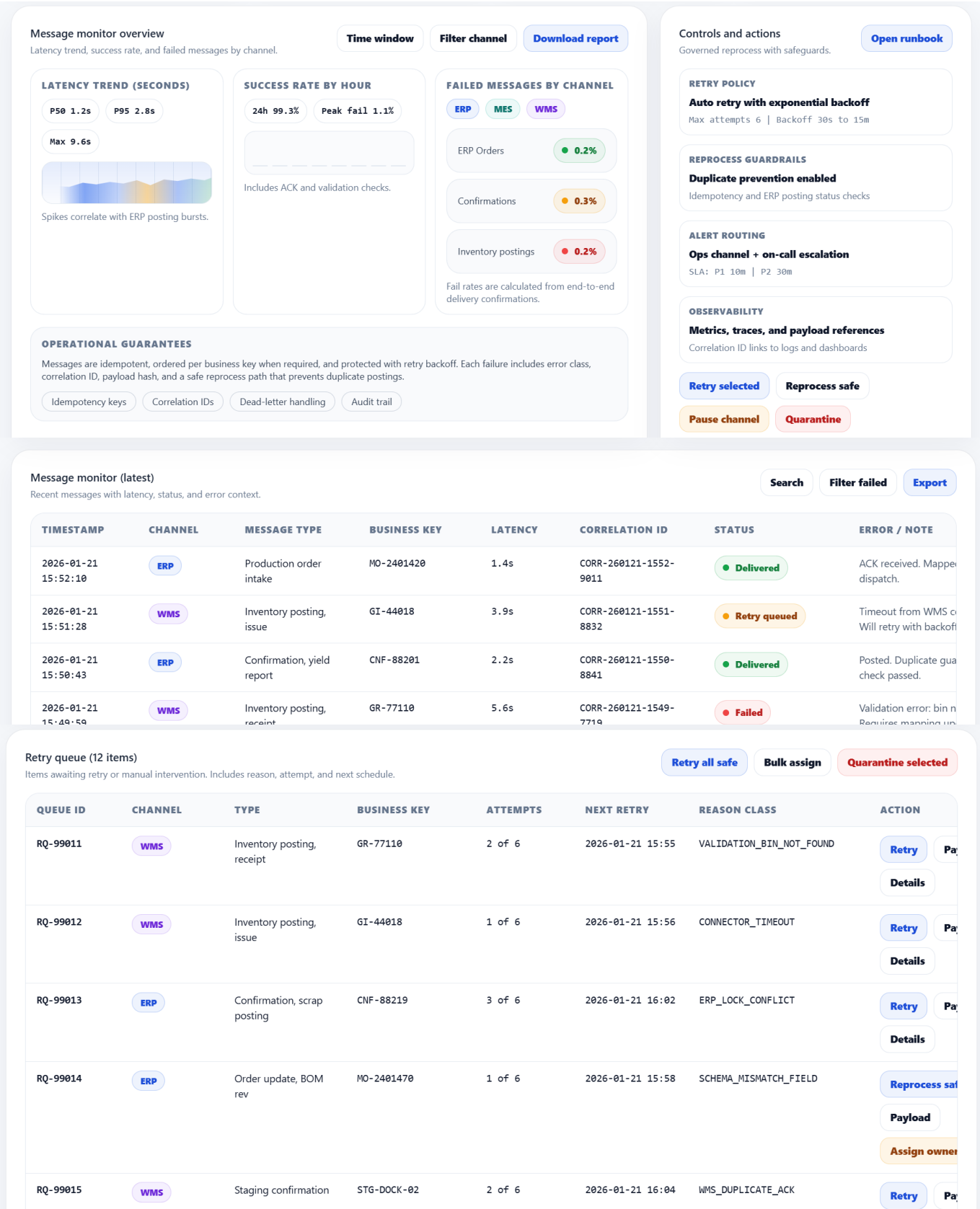
2.8s

Order to MES dispatch

Retry queue

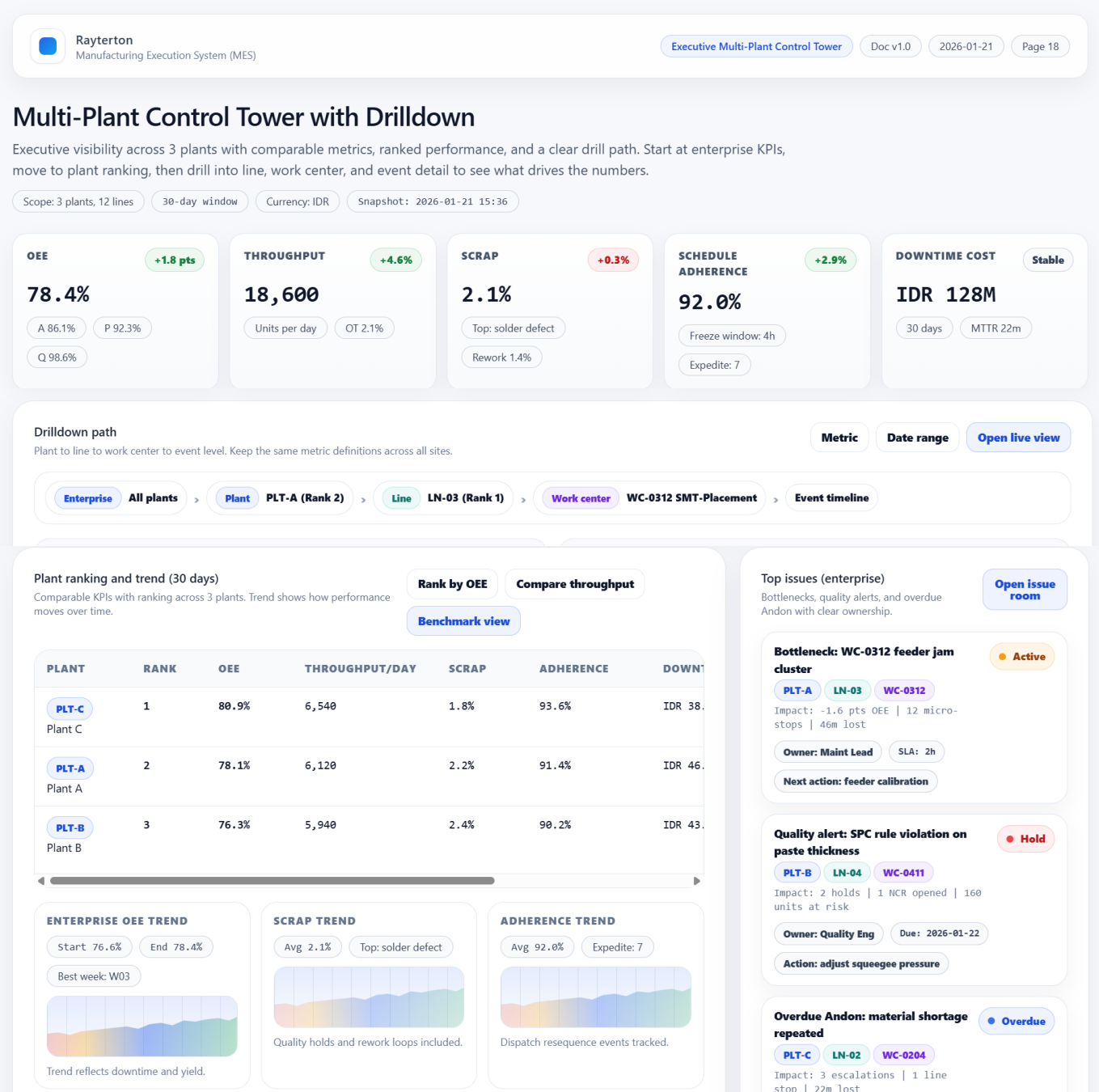
12 pending

Auto retry enabled with backoff



Multi Plant Control Tower with Drilldown

This is the executive view that connects outcomes to root causes. KPI tiles cover OEE, throughput, scrap, schedule adherence, and downtime cost, with 30 day trends. Top issues list highlights bottlenecks, quality alerts, and overdue Andon. Drilldown path is consistent and fast: plant to line to work center to event. Leadership can see ranking across 3 plants and then open the exact event chain behind performance gaps.



Glossary

API (Application Programming Interface)

A standard way for software systems to exchange data automatically.

BI (Business Intelligence)

Tools used for reporting, dashboards, and business data analysis.

CAPA (Corrective and Preventive Action)

A process to fix quality problems and prevent them from happening again.

CMMS (Computerized Maintenance Management System)

Software for managing equipment maintenance and maintenance work orders.

EBR (Electronic Batch Record)

A complete digital record for one production batch.

ERP (Enterprise Resource Planning)

The main business system for managing orders, finance, inventory, and production.

IoT (Internet of Things)

Connected devices and sensors that send machine data to software systems.

KPI (Key Performance Indicator)

A key number used to measure performance, such as efficiency or downtime.

LIMS (Laboratory Information Management System)

Software for managing laboratory test data and results.

MES (Manufacturing Execution System)

Software that controls and tracks shop floor production in real time.

MRP (Material Requirements Planning)

A system that calculates what materials are needed for production.

MTBF (Mean Time Between Failures)

The average operating time before equipment breaks down.

MTTR (Mean Time To Repair)

The average time required to repair equipment after a failure.

NCR (Nonconformance Report)

A report for products or processes that do not meet requirements.

OEE (Overall Equipment Effectiveness)

A key metric that combines machine availability, speed, and quality.

PLC (Programmable Logic Controller)

An industrial computer that controls machines and reads machine signals.

QMS (Quality Management System)

Software used to manage quality processes and documentation.

SCADA (Supervisory Control and Data Acquisition)

A system for monitoring and controlling industrial processes.

SLA (Service Level Agreement)

A defined target time for responding to and resolving issues.

SPC (Statistical Process Control)

Statistical methods used to monitor and control process performance.

SSCC (Serial Shipping Container Code)

A unique code used to identify pallets and shipping containers.

WMS (Warehouse Management System)

Software for managing warehouse operations and inventory.

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requirements**

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**No Change
Request (CR)
fees during
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