

OFFICIAL MANUAL GUIDE

Production Supervisor Mastery

AI-Assisted Production Control
for the Manufacturing Shop Floor

CASE STUDY

Generator and Base-Frame Manufacturing Shop Floor

FACTORY MODEL

Laser Cutting, Plasma Cutting, Shearing, Press Brakes, Punching, Powder Coating, Assembly, and Dispatch

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VERSION

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AI supports planning, visibility, analysis, and reporting. Authorized personnel retain operational, technical, quality, safety, cybersecurity, and delivery authority.

OVERVIEW

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PART ONE

Programme Framework

- 1 Programme Objective & Boundaries
- 2 Eight-Department Operating Model
- 3 End-to-End Department Workflow
- 4 Phased Implementation (Phases 0–7)
- 5 15-Day Programme at a Glance

PART 1 • BEFORE DAY 1

Programme Objective & Boundaries

AI assists with planning, visibility, analysis and reporting, while authorized people retain operational, technical, quality, safety and delivery authority.

By Day 15 you will build a lightweight, AI-assisted production-control system that can

- Track orders from customer confirmation to dispatch
- Confirm drawing, material, tooling, program and inspection readiness
- Capture shop-floor updates using QR codes or mobile forms
- Calculate production and departmental KPIs
- Identify delayed jobs, missing parts, repeated downtime and quality risks
- Generate supervisor-reviewed daily briefings and handover reports
- Maintain safety, quality, maintenance, AI-governance and cybersecurity records
- Escalate exceptions to the correct department
- Give one reliable production status instead of disconnected spreadsheets and messages

TOOLS THE SYSTEM MAY USE

- Excel / Google Sheets
- Microsoft Forms or approved mobile form
- Power BI or Excel dashboard
- Power Automate / Make / Zapier / n8n
- SharePoint / OneDrive (controlled repository)
- Organization-approved AI assistant

NEVER REPLACED BY THE SYSTEM OR BY AI

- CNC or machine controllers
- PLCs, HMIs, interlocks, safety circuits
- Machine guarding or emergency stops
- Lockout/tagout procedures
- Engineering approval and quality inspection
- Maintenance diagnosis
- ERP/MES controls already required
- Supervisor, operator, HSE, quality or management authority

PART 1 • SECTION 2

Eight-Department Operating Model

Each department owns a clear responsibility, a set of automations, where AI may assist, and who must give human approval.

Department	Responsibilities	Automation & AI support	Human approval
1 • Sales & Customer Service	Receive requirements; confirm order number, quantity, due date, specification, priority; record changes; communicate approved delivery commitments.	Order-entry form, order-change log, delivery-risk notification, commitment register. AI summarizes orders and spec changes, drafts status updates, flags orders at risk.	Sales or management approve commitments. AI must not promise delivery dates.
2 • Engineering & Design	Release drawings; control revisions; prepare BOMs; confirm material grades and thicknesses; define routing; approve technical deviations.	Drawing-revision register, engineering-release checklist, BOM and CNC-program readiness. AI spots obsolete or conflicting revisions and summarizes open issues.	Only authorized engineering approves drawings, revisions, substitutions, process changes or deviations.
3 • Production Planning & Control	Create production orders and job travelers; confirm routing; load machines; release work; control priorities; track WIP.	Master tracker, machine-capacity sheet, job-readiness gate, schedule and WIP boards, delay and shortage alerts. AI drafts schedule options and identifies route conflicts.	Supervisor or authorized planner makes final release and priority decisions.
4 • Procurement & Supplier Coordination	Buy material, powder, consumables, tooling and spares; confirm supplier dates; escalate late deliveries.	Requisition tracker, shortage register, supplier-delivery tracker, late-PO alert, critical-spares list. AI ranks shortages by delivery impact and drafts follow-ups.	Procurement approves orders, suppliers, prices and commercial commitments.
5 • Stores, Material Control & Logistics	Receive and inspect material; identify by grade, thickness, heat/batch; issue against jobs; control remnants, WIP locations, scrap, finished goods.	Receiving form, availability board, stock and remnant register, QR material locations, WIP transfer form, mismatch alerts. AI highlights shortages and excess.	Stores confirm physical identity and quantity. System stock is never assumed to equal actual stock.
6 • Manufacturing Operations	Cutting, forming, welding, assembly, powder coating, final assembly, packing. Record start, stop, completion, scrap, downtime, holds; maintain traceability.	QR job traveler, operator-update form, machine-status board, digital shift report, downtime register, quality/safety holds. AI summarizes output and top losses.	Qualified operators run machines; supervisors approve priorities; maintenance approves technical work; HSE controls safety.
7 • Quality & HSE	Incoming, first-off, in-process and final inspection; NCR control; rework and concessions; calibration. HSE: machine safety, authorization, incidents, permits, LOTO, powder-coating and fire hazards.	First-off form, digital NCR/rework log, inspection-hold status, near-miss form, machine-safety checklist, LOTO register. AI summarizes repeat defects and drafts Pareto from approved records.	AI output is not a quality release, risk assessment, root-cause conclusion or restart authorization.
8 • Maintenance, IT/OT & Automation Support	Preventive and corrective maintenance; control settings; maintain CNC/PLC/HMI/network asset information; backups; remote access, USB, accounts,	PM tracker, breakdown report, machine history, OT asset register, remote-access log, approved-USB register, backup/restore register.	Maintenance diagnoses and approves interventions; IT/OT approves access. AI never commands machines,

Department	Responsibilities	Automation & AI support	Human approval
	segmentation; support dashboards.	AI summarizes history and highlights repeat failures.	controllers, extraction or safety equipment.

MACHINE STRUCTURE USED IN THIS PROGRAMME

Lasers L1, L2, L3 · Plasma PL1 · Shears SH1–SH3 · Press brakes BR1–BR5 · Punching PU1 · Powder-coating line PC1 · Welding/assembly cells WA1, WA2 · Final assembly/packing FA1

PART 1 • SECTION 3

End-to-End Department Workflow

Every order moves through eight steps. Each step ends with a system status, and no step is skipped.

Step	What is confirmed	System status
1 • Order entry	Sales enters customer order, quantity, requested date, specification, priority	ORDER RECEIVED
2 • Engineering release	Drawing revision, BOM, material spec, routing, CNC/program availability, inspection points, approved alternative processes	ENGINEERING RELEASED
3 • Material confirmation	Material available and physically identified; powder colour and consumables; critical bought-out parts available or dated	MATERIAL READY
4 • Planning release	Drawing, material, program, tooling, machine capacity, operator availability, quality and safety requirements	READY FOR SUPERVISOR RELEASE
5 • Manufacturing execution and internal transfer	Operators scan the job at start, stop, downtime, partial and full completion, quality hold, safety hold and transfer	IN CUTTING • IN BENDING • IN ASSEMBLY • AWAITING COATING • QUALITY HOLD • SAFETY HOLD • AWAITING MATERIAL • COMPLETE
6 • Quality release	Quality records inspection outcome and any NCR or rework requirement	QUALITY RELEASED
7 • Final assembly & dispatch	All parts present; packing, documentation and collection readiness confirmed	READY FOR DISPATCH
8 • Performance review	Daily report, at-risk list, department actions, downtime and quality Pareto, shortage report, maintenance status, safety and cyber exceptions	—

LABELLING RULE

All AI-generated content must be labelled: **Draft — Human Review Required**

PART 1 • SECTION 4

Phased Implementation: Phases 0–7

A suggested deployment sequence after the programme, each phase with a single governing rule.

PROGRAMME VS DEPLOYMENT TIMELINE

The 15-day programme is **guidance**. The phased implementation below is a suggested **post-programme deployment timeline** — the weeks shown are indicative, not part of the 15 days.

Phase	Duration	What is built	Key rule
0 • Safety & Governance Gate	Week 1	Machine-specific safety checklists, authorization matrix, safety/quality holds, LOTO verification, near-miss reporting, powder-coating checks, approved AI-tool register, data classification, IT/OT separation, manual fallback	Exit: the system cannot mark a safety-held or quality-held job as ready to run
1 • Master Data	Weeks 2–3	Machine, employee, routing registers; downtime and defect codes; responsibility matrix; job-status definitions; drawing-revision rules; shift calendar; capacity assumptions	Dashboards and AI are unreliable if codes and statuses are inconsistent
2 • QR Job Traveler	Weeks 4–5	Pilot: one laser (L1), one press brake (BR1), one product family (canopy doors), one shift, small trained group	Paper stays as controlled fallback during pilot
3 • Daily Dashboard	Weeks 6–7	Safety, jobs planned/completed, plan vs actual, machine status, downtime, shortages, holds, orders at risk, action owners, WIP, dispatch readiness	An exception board, not hundreds of charts
4 • Alerts & Workflow	Weeks 8–9	Safety hold, breakdown limit, job not started, quantity below plan, shortage, pending first-off, NCR, drawing change, overdue PM, delivery risk	Avoid minor alerts — alert fatigue
5 • Reports & AI Summaries	Weeks 10–11	Morning briefing, end-of-shift, department actions, weekly downtime and quality, shortage risk, maintenance trend, delivery risk	Every report shows source, refresh time, AI label, reviewer, approval
6 • Intelligent Scheduling	Weeks 12–14	Priority scoring and schedule options A–D	Only after QR and dashboard data are reliable
7 • Predictive Analytics	Week 15+	Repeat failures, abnormal cycle time, scrap risk, late-order risk, bottleneck and supplier-delay trends	Predictions are risk indicators, not diagnoses

RECOMMENDED STARTING POINT

Safety, quality holds and governance → master data and status codes → digital job traveler and QR tracking → daily dashboard → alerts and reports → analytics → intelligent scheduling. The first pilot is QR job tracking linked to a simple dashboard, only after safety-hold, quality-hold, operator-authorization and manual-fallback controls are active.

PART 1 • SECTION 5

15-Day Programme at a Glance

Each day ends with one concrete deliverable that becomes part of the final pack.

DAYS 1–5 • ESTABLISH OPERATIONAL CONTROL

Day	Topic	Deliverable
1	End-to-end production flow and bottlenecks	Current-state process map
2	Machine capacity, routing and workload planning	Machine capacity and routing sheet
3	Job travelers, work orders and data discipline	Digital job traveler
4	Daily production control and the morning meeting	Daily production board and meeting agenda
5	KPI fundamentals and the supervisor dashboard	Dashboard v1 (KPI board)

DAYS 6–10 • INTRODUCE CONTROLLED AUTOMATION

Day	Topic	Deliverable
6	AI, automation, MES, CNC and PLC boundaries	AI use-case register
7	Safe prompting and data handling	Prompt library
8	QR and mobile data capture	Production update system
9	Workflow automation	Workflow v1
10	AI-assisted daily meeting	Daily report template

DAYS 11–15 • PROFESSIONAL IMPLEMENTATION

Day	Topic	Deliverable
11	Intelligent scheduling	Approved schedule board
12	Maintenance and downtime intelligence	Maintenance intelligence pack
13	Quality, safety and traceability	Quality/HSE control pack
14	Cybersecurity and AI governance	AI/OT governance pack
15	Capstone simulation	Final dashboard and SOP pack

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PART TWO • DAYS 1-5

Establish Operational Control

- 1 Production Flow and Bottlenecks
- 2 Machine Capacity, Routing and Workload
- 3 Job Travelers and Data Discipline
- 4 Daily Production Control and the Morning Meeting
- 5 KPI Fundamentals and the Dashboard

DAY 1

Understanding the Production Flow and Finding Bottlenecks

Start slowly and practically. Each lesson is explained in simple language — as if teaching someone new to manufacturing — while still developing you into a professional production supervisor.

TODAY'S DELIVERABLE · Current-State Production Process Map — how one generator canopy order moves from customer order to dispatch.

BY THE END OF DAY 1 YOU CAN

- Explain what production flow means
- Describe how a generator order moves through the factory
- Identify the eight departments involved
- Distinguish between a process step, delay, queue and bottleneck
- Draw a simple current-state process map
- Identify where an order is delayed and who should take action

What is production flow?

Production flow is the movement of an order through all the activities required to manufacture and deliver it. Think of a restaurant: the waiter receives the order, the kitchen checks ingredients, the chef prepares the food, another person checks it, and the waiter delivers it. A factory works the same way — when a customer orders a generator canopy, several departments must complete their responsibilities before steel is cut.



REMEMBER

If one important step is missing, production can be delayed.

The eight departments and the supervisor's concern

Department	Example	Supervisor's concern
1 • Sales & Customer Service	A customer orders ten generator canopy sets due in five days. Sales creates order G-101, 10 canopy sets.	Never assume every customer date is achievable. Check readiness and capacity before confirming.
2 • Engineering & Design	Engineering releases a canopy-door drawing as Revision 3. If production uses Revision 2, the wrong part is made.	Is the drawing approved? Is the revision correct? Is the CNC program available? Are inspection points defined?
3 • Production Planning & Control	The planner assigns canopy panels to Laser L2, which already has eight hours waiting. Better: divide approved work across L1, L2, L3.	Check that the plan is realistic before releasing it to operators.
4 • Procurement & Supplier Coordination	The drawing requires 2 mm galvanized steel, not in stock. Ordered, but the supplier has not confirmed a date.	The order must not appear fully ready if a critical material is missing.
5 • Stores & Material Control	The computer shows ten sheets in stock, but only six can be physically found.	System stock is not enough. Material must be physically confirmed before release.
6 • Manufacturing Operations	Cutting (L1–L3, PL1, SH1–SH3, PU1), forming (BR1–BR5), finishing (PC1), welding, assembly, packing.	Coordinate operators, machines, materials, drawings, priorities, checks, downtime and handover — ensure the whole system works together.

Department	Example	Supervisor's concern
7 • Quality & HSE	Inspection stages: first-off, post-cut, post-bend, weld, pre-coating, post-coating, final. HSE controls safety, LOTO, PPE, fire and powder-coating risk.	A job on quality or safety hold must not continue simply because the delivery date is urgent.
8 • Maintenance, IT/OT	Availability, PM, breakdown response, machine history; accounts, dashboards, backups, approved USB, remote access.	Report the production effect of a breakdown; Maintenance investigates the technical cause. AI must not change a CNC, PLC, oven or safety system.

The generator canopy production route

THE ORDER

Order G-101 • Generator canopy • 10 sets • Due in five days • **Material:** mild-steel sheets • **Powder-coating colour:** green

Stage	What happens	Required status / note
1 • Sales order	Sales records the order: quantity, specification, colour, delivery date	—
2 • Engineering release	Drawings, BOM, revisions, cutting information, routing	ENGINEERING RELEASED
3 • Material preparation	Procurement and stores confirm the correct material is physically available	MATERIAL READY
4 • Production planning	Planning checks machine capacity and prepares the sequence	READY FOR SUPERVISOR REVIEW
5 • Cutting	Doors, roof panels, side panels, brackets cut on approved machines	L1, L2, L3, PL1, SH1-SH3 or PU1 per approved process
6 • Bending	Cut components move to press brakes	BR1-BR5; check a first-off before the remaining quantity
7 • Welding & subassembly	Formed components welded or assembled per drawing	—
8 • Pre-coating preparation	Components checked, cleaned, prepared	—
9 • Powder coating	Compatible components grouped by colour where practical	PC1 — never compromise ventilation, grounding, housekeeping, fire prevention or coating requirements to save time
10 • Final assembly	Coated components assembled with doors, hinges, locks	—
11 • Final inspection	Quality checks the completed product	—
12 • Packing & dispatch	Stores or dispatch confirms the order is complete and ready	—

Bottleneck, delay, problem and constraint

A bottleneck is a process that limits the speed or output of the whole system — like the narrow neck of a bottle. If cutting produces 100 components per shift but bending can process only 60, work accumulates before the press brakes. Identify the bottleneck from evidence, not assumption: queue length, waiting time, available capacity, output, downtime, cycle time, WIP and delivery impact.

Term	Meaning	Example
Bottleneck	A process that limits the output of the whole flow	All canopy parts pass through PC1, which cannot process them fast enough
Delay	An event that causes work to start or finish late	A forklift takes 40 minutes to move parts from cutting to bending
Problem	Something incorrect that requires action	BR3 produces components with an incorrect bend angle
Constraint	A condition that limits what can be done	Only one trained operator is authorized to run PL1
Queue	Jobs waiting for the next process	Eight cutting jobs are waiting in front of L2
WIP	Material that has entered production but is not complete	Panels cut but waiting for bending

Practical case study — 8:00 a.m. on the floor

Area	Situation
Sales	G-101 is due in five days
Engineering	One door drawing is awaiting final approval
Stores	Most steel is available, but one thickness has not been located
Cutting	L1 has two jobs, L2 has eight jobs, L3 has one job
Bending	BR1 and BR2 running; BR3 has an angle problem
Welding	Welders are waiting for side panels
Powder coating	PC1 is running black jobs; G-101 requires green
Quality	Two first-off inspections are waiting
Maintenance	BR3 is waiting for inspection

Q1 • What should the supervisor do first? Check for safety holds, quality holds, missing or unreleased drawings, missing material, machine breakdowns and jobs affecting urgent orders. Do not begin by moving jobs randomly between machines.

Q2 • Is L2 definitely the bottleneck? No. L2 has the longest queue, but check each job's processing time; whether L1 and L3 can run them; whether programs and material are ready; whether bending can receive more cut parts; and whether delivery is limited elsewhere. A long queue is a warning sign, not proof.

Q3 • What action on BR3? Stop affected production; record a quality hold; isolate questionable components; notify quality, maintenance and the supervisor; check the first-off record, tooling, setup, drawing revision and material; move work only if an approved alternative machine and validated method exist; restart only after required human approval. AI may summarize the incident but cannot diagnose the machine or authorize restart.

Q4 • Change PC1 from black to green immediately? Not automatically. Compare the quantity remaining in the black batch, due dates, G-101 readiness, colour-change time, cleaning and inspection requirements, downstream capacity and the delivery risk of either decision — then choose the sequence that best protects delivery without unnecessary colour changes.

Building the current-state process map

A current-state map shows how production operates today — including delays and problems — not an imaginary perfect factory. It also shows where work must stop and who makes the decision.

Decision	If NO / YES	Owner
Is the drawing released?	No → Engineering hold · Yes → continue	Engineering
Is material physically available?	No → Material hold · Yes → continue	Stores / Procurement
Did first-off inspection pass?	No → Quality hold · Yes → continue	Quality
Is there a safety concern?	Yes → Safety hold · No → continue	HSE

How digital tracking and AI help

Paper job cards, separate Excel files, phone calls and messages can make information late, incomplete or hard to verify. A simple digital workflow fixes this:

Operator scans job QR › Selects job status › Central tracker updates › Dashboard refreshes › Owner alerted on serious exception ›

AI INPUT — APPROVED PRODUCTION INFORMATION

G-101 due in five days · door drawing not released · one material thickness unconfirmed · L2 has eight jobs waiting · BR3 on quality hold · two first-off inspections pending · PC1 running black while G-101 requires green

Draft — Human Review Required

G-101 is at risk because its door drawing is not released, one required material thickness is unconfirmed, and BR3 is on quality hold. The supervisor should first confirm safety and quality status, assign engineering and stores actions, and review whether approved work can be balanced between L1 and L3. Review the powder-coating sequence after confirming when G-101 components will reach coating.

DAY 1 — PROFESSIONAL LESSON

A weak supervisor asks: "Why is production slow?"

A professional supervisor asks: "Which operation is limiting flow, what evidence proves it, which orders are affected, who owns the action, and when will it be resolved?"

Do not manage production by assumption. Follow the order through the complete process, identify the real restriction, assign an owner, and verify the result.

DAY 2

Machine Capacity, Routing and Workload Planning

Yesterday you learned how an order moves through the factory. Today you learn how a professional supervisor decides which machine does each job and whether it has enough time to complete it.

TODAY'S DELIVERABLE · Machine Capacity and Routing Sheet.

What is machine capacity?

Machine capacity is the amount of approved work a machine can complete within a given time. A bus has 40 seats: 30 students fit, 55 do not. A laser with 420 available production minutes and jobs needing 600 minutes is overloaded.

FOUR IMPORTANT TIME TERMS

Term	Meaning and example
Shift time	Total time from start to end of a shift. An eight-hour shift = $8 \times 60 = 480$ minutes — but not all of it is available.
Available time	Time planned for production after removing scheduled non-production time: $480 - 30 \text{ break} - 10 \text{ meeting} - 20 \text{ planned maintenance} = \mathbf{420 \text{ minutes}}$. Do not remove breakdowns in advance — record them as downtime so the real loss is visible.
Setup time	Time to prepare a machine: loading the program, tooling, die change, material change, parameter setting, first-off. Example: BR1 needs 30 minutes to prepare for a canopy door — that 30 minutes must be in the workload.
Cycle time	Time to produce one unit. A press brake at 4 minutes per component: $60 \times 4 = 240 \text{ min}$; add 30 min setup → 270 minutes.

The capacity calculation

FORMULAS

Required time = Setup time + (Cycle time × Required quantity)

Machine load % = Required time ÷ Available time × 100

WORKED EXAMPLE — BR1 LOAD

Processing time	4×60	240 min
Add setup	$240 + 30$	270 min
Workload	$270 \div 420 \times 100$	64.3%
Time left	$420 - 270$	150 min

MAXIMUM POSSIBLE QUANTITY

Remove setup	$420 - 30$	390 min
Divide by cycle time	$390 \div 4$	97.5
Planning figure	full components only	97

A PLANNING ESTIMATE, NOT A PROMISE

97 holds only if there is no breakdown, no rejection, material is continuous, the operator stays available, one setup is enough and cycle time stays at four minutes. A professional supervisor does not promise 97 pieces blindly.

Routing, primary and alternative machines

A route is the approved sequence of operations required to manufacture a part. Example — generator canopy door:

Stores ›

Laser L1/L2/L3 ›

Post-cut inspection ›

Press brake BR1/BR2/BR4/BR5 ›

Post-bend inspection ›

Welding WA1 ›

Pre-co

IMPORTANT RULE

Machine availability does not mean machine suitability. Never choose plasma, shearing or punching merely because the laser is busy. Engineering must approve technical alternatives when required.

Case study — three orders on L2

Order	Product	Due	Planned	Laser time
G-101	10 canopy sets	5 days	L2	300 min
G-102	6 control-panel enclosures	3 days	L2	180 min
G-103	15 base-frame brackets	Tomorrow	L2	120 min

L2 has 420 available minutes. Total workload = $300 + 180 + 120 = 600$ min. Shortage = $600 - 420 = 180$ min over. Load = $600 \div 420 \times 100 = 142.9\%$.

CONCLUSION

L2 is overloaded by 180 minutes (about 143%). The schedule cannot be completed in one normal shift.

What should the supervisor do? Not "work faster." Check safety and readiness; protect the urgent order (G-103, due tomorrow, L2-only); check alternative-machine approval (move approved G-101 panels to L1, approved G-102 parts to L3 — example only, subject to program, material, capability and engineering approval); check the next operation so cut parts don't just queue at bending; and record the decision (original machine, new machine, reason, approver, new completion, effect on other orders).

DAY 2 — PROFESSIONAL LESSON

A weak supervisor says: "The machine looks free, so put the job there."

A professional supervisor says: "Confirm the machine is approved, calculate its available minutes, include setup and cycle time, check the downstream operation, and record the authorized routing decision."

A machine schedule is measured in required time, not the number of jobs. The question is: how many approved production minutes are needed, and how many are actually available?

DAY 3

Job Travelers, Work Orders and Production Data Discipline

Before AI, dashboards and automation can help, there must be one thing: accurate production data. This is one of the most important days in the course.

TODAY'S DELIVERABLE · Digital Job Traveler for the generator canopy door.

WHY FACTORIES FAIL WITH AUTOMATION

Job numbers are wrong · operators do not record actual quantities · drawing revisions are unclear · nobody knows where a job is · status depends on phone calls and messages. A professional supervisor never manages production using assumptions.

Work order vs job traveler

A **work order** is official authorization to produce — a manufacturing contract between planning and production. A **job traveler** moves with the product through the factory, like a patient's hospital file: it tells every department what the job is, where it came from, what was completed, what comes next, and whether inspection passed.

Work-order field	Example
Customer	ABC Power Ltd
Order	Generator Canopy
Quantity	10 units
Due date	15 October
Job number	G-101
Material	2 mm mild steel
Drawing revision	Rev 05

RELEASE RULE

A work order may be released for production only after the job-readiness checks, approvals, and safety requirements are confirmed.

Why factories lose control

THE CONVERSATION NOBODY WANTS

Planner: "Where is Job G-101?" · Supervisor: "I think it is in bending." · Bending: "We finished it yesterday." · Welding: "We haven't received it." · Stores: "Material is still here." — This is lost visibility. A good traveler prevents it. Never accept "I think."
Always ask: "Show me the record."

INFORMATION EVERY TRAVELER MUST CONTAIN

JOB IDENTIFICATION

Job number	G-101
Customer	ABC Power
Part number	CP-001
Part name	Canopy Door
Quantity	10
Due date	15 Oct
Priority	High

ENGINEERING CONTROL

Drawing number	DR-001
Revision	Rev 04
Program number	L2-CP001
Material grade	MS
Thickness	2 mm

PROCESS ROUTE

Cutting	L2
Bending	BR2
Welding	WA1
Coating	PC1
Assembly	FA1

PRODUCTION TRACKING & QUALITY

Start time	08:00
Finish time	09:30
Good qty	10
Scrap qty	0
First-off	Pass
Final check	Pass

The values above are illustrative. In practice each job carries one revision, one due date and one consistent set of quantities — here the canopy-door job is quantity 10, so good + scrap must not exceed 10. A traveler is only useful if its values match the work order.

The five statuses every supervisor must track

Status	Meaning
Ready	Everything available
Running	Currently being produced
Waiting	Waiting for material, drawing, tooling, inspection or labour
Hold	Quality hold or safety hold
Complete	Finished and approved

Most factories track only Started and Finished — that is not enough. A status history makes events clear: 08:00 Running → 10:15 Quality Hold (bend-angle defect) → 12:00 Running → 15:00 Complete.

Operator data and downtime discipline

DATA OPERATORS RECORD (QR, DAY 8)

- Date, shift, job number, machine code, operator ID
- Start / finish time
- Good quantity, scrap quantity
- Downtime and downtime reason
- Inspection status, next operation

STANDARD DOWNTIME REASONS

Bad: "Machine problem."

Good: material shortage · program issue · tool change · breakdown · waiting for drawing · quality hold · setup · forklift/ material movement · planned maintenance.

BAD DATA + AI = BAD DECISIONS FASTER

An operator produces 90 units but records 100. AI reports "on target," while assembly still waits for parts. The AI is not wrong — the data is wrong. AI learns from standardized data and struggles with random descriptions.

Case study — Order G-103 (15 base-frame brackets, due tomorrow)

Time	Event	Record
Morning	Job released	Status: Ready
10:00	Operator starts cutting	Running
11:00	Machine stops	Downtime reason: Nozzle change
11:20	Production resumes	Running (20 min downtime)
1:00 PM	Cutting completed	Good parts 15 · Scrap 1
2:00 PM	Job transferred to BR2	Next operation: bending
3:00 PM	Inspector finds defect	QUALITY HOLD
4:00 PM	Correction completed	RUNNING
5:00 PM	Operation completed	Complete

Without a traveler, could management know what happened? No. The traveler creates visibility. The principle: **AI recommends; the supervisor decides.**

DAY 3 — PROFESSIONAL LESSON

A weak supervisor asks: "Where is the job?"

A professional supervisor asks: "Show me the job traveler, current status, quantity completed, downtime recorded, next operation, and owner of the next action."

If the traveler is accurate, the supervisor controls production. If it is inaccurate, production controls the supervisor.

DAY 4

Daily Production Control and the Morning Production Meeting

Many supervisors spend the day reacting to problems. Professional supervisors control production before problems become emergencies.

TODAY'S DELIVERABLE · Daily Production Board and a 15-minute morning meeting agenda.

The 7:30 a.m. check — production starts before the operators do

Production does not start at 8:00 when operators touch the machine; it starts with the supervisor's checks at 7:30.

Department	Morning question
Sales	Any urgent customer order?
Engineering	Any drawing revision changes?
Procurement	Any material shortage?
Stores	Is material physically available?
Production	Are machines available?
Quality	Any jobs on hold?
Maintenance	Any machine breakdown?
Dispatch	Any delivery due today?

Only after these checks is production released. The supervisor's daily mission answers five questions: What must be delivered? What can realistically be produced today? What may stop production? Who owns each problem? What actions are required now?

The daily production board

1 • PRIORITY ORDERS

G-103	PowerTech	Tomorrow · Critical
G-102	XYZ Energy	3 days · High
G-101	ABC Power	5 days · Normal

4 • DOWNTIME

L2	60 min	Nozzle change
BR3	90 min	Quality issue

2 / 3 • PLANNED VS ACTUAL OUTPUT

Machine	Planned	Actual
L1	120	115
L2	100	98
BR1	80	76
BR2	70	65
PC1	60	60

5 • HOLDS

G-101	Quality hold
G-105	Material hold

READING THE BOARD

Planned output = 430 parts (120 + 100 + 80 + 70 + 60). Actual output = 414 parts (115 + 98 + 76 + 65 + 60). Plan attainment = $414 \div 430 \times 100 = 96.3\%$. The two biggest gaps are L1 and BR2 — 5 parts each.

The morning meeting and managing exceptions

A good meeting lasts 10–15 minutes, not an hour: (1) Safety — accidents, near misses, holds (always first); (2) Yesterday's results — plan vs actual, downtime, scrap, delivery; (3) Today's priorities — Critical G-103, High G-102, Normal G-101; (4) Problems — shortages, missing drawings, breakdowns; (5) Assign actions — every problem gets an owner, deadline and status.

WRONG BEHAVIOUR

Material missing. Supervisor: "Somebody should check it."
Nobody knows who. The problem remains.

PROFESSIONAL BEHAVIOUR

Material missing. Owner: Stores Manager · Action: locate material · Deadline: 10:00 a.m. · Status: Open.

Of 100 jobs running, about 95 are normal and 5 have issues — focus on the 5. The production-control formula: **what must be produced + what resources are available + what problems are expected = today's production plan.**

DAY 4 — PROFESSIONAL LESSON

A weak supervisor starts the shift and waits for problems.

A professional supervisor starts by identifying what must be done, what could go wrong, who owns each issue and when action must be completed.

Production does not fail because of the problems you know. It fails because of the problems you failed to identify before the shift started.

DAY 5

KPI Fundamentals and the Production Supervisor Dashboard

A factory cannot improve what it does not measure. Today: measuring performance using KPIs and building a simple supervisor dashboard.

TODAY'S DELIVERABLE · Dashboard v1 (KPI board).

A KPI (Key Performance Indicator) is a number that tells us how well a process is performing — a factory's scoreboard. Without KPIs: "Production feels busy... I don't know." With KPIs: "Planned 500, actual 450, plan attainment 90%, downtime 120 min, scrap 4%, on-time 95%." Now decisions use facts.

The seven most important production KPIs

KPI	Formula	Example
1 • Plan attainment	Actual output ÷ Planned output × 100	$450 \div 500 \times 100 = 90\%$
2 • Output	Total good parts produced	L1 120 + L2 95 = 215 parts
3 • Scrap rate	Scrap qty ÷ Total qty × 100	$5 \div 100 \times 100 = 5\%$
4 • Downtime	Minutes production should run but is stopped	L2 10:00 → 11:30 = 90 min (reason recorded)
6 • On-time completion	Jobs completed on time ÷ Jobs due × 100	$18 \div 20 \times 100 = 90\%$
7 • WIP	Jobs started but not finished	Cut, waiting for bending — monitor daily

Plan-attainment result	Meaning
100%+	Target achieved
95–99%	Good
90–94%	Needs attention
Below 90%	Serious review required

KPI 5 — OEE Components: Supervisor Introduction

Component	Meaning	Example
Availability	Was the machine running?	$480 \text{ scheduled} - 60 \text{ downtime} = 420 \text{ running} \rightarrow 420 \div 480 = 87.5\%$
Performance	Did it run at expected speed?	Calculated later in the course
Quality	Did it produce acceptable parts?	$95 \text{ good} + 5 \text{ scrap} \rightarrow 95 \div 100 = 95\%$

DO NOT REPORT OEE EARLY

Do not report OEE until Availability, Performance, and Quality are all measured using approved definitions. Today you only need this supervisor introduction; full OEE comes later.

Case study — the generator factory

Machine	Planned	Actual	Gap
L1	100	98	-2
L2	120	90	-30
L3	100	97	-3
BR1	80	76	-4
BR2	70	69	-1
Total	470	430	-40

Plan attainment = $430 \div 470 \times 100 = 91.5\%$ → Needs attention (90–94%). The largest gap is L2 (-30 parts): possible downtime, material shortage, quality hold, setup delay or operator absence. A professional supervisor investigates the cause.

Additional KPI	Calculation
Rework rate	$\text{rework qty} \div \text{total produced qty} \times 100$
Downtime %	$\text{downtime minutes} \div \text{scheduled production minutes} \times 100$
First-pass yield	$\text{qty passing without rework} \div \text{inspected qty} \times 100$
WIP age	$\text{current date/time} - \text{operation-entry date/time}$

Building the KPI dashboard

Every morning the dashboard shows six groups — Safety, Production, Quality, Maintenance, Delivery, Materials — as an exception board, not hundreds of charts. Example day: Safety 0 incidents / 1 observation · Production plan attainment 91.5%, output 430 · Quality scrap 3.2%, rework 2.1% · Maintenance downtime 170 min · Delivery on-time 95% · WIP 28 open jobs. Every red indicator needs an owner and an action.

AI INPUT — APPROVED DATA ONLY

Plan attainment 91% · Downtime 170 min · Scrap 4% · 5 orders at risk

Draft — Human Review Required

Production achieved 91% of plan. The largest losses came from downtime and quality-related interruptions. Five orders remain at risk. Supervisor attention should focus on downtime causes, inspection delays and overdue jobs.

Five mistakes new supervisors make: measuring output only; ignoring scrap; ignoring downtime; tracking too many KPIs; collecting data but taking no action. AI only becomes intelligent when the production data is accurate.

DAY 5 — PROFESSIONAL LESSON

A weak supervisor says: "Production was busy today."

A professional supervisor says: "Plan attainment was 91.5%, downtime 170 minutes, scrap 3.2%, and two jobs missed planned completion because of machine downtime and delayed inspections."

Production management is not about opinions. It is about measurable performance, visible results and corrective actions.

03

PART THREE • DAYS 6-10

Controlled Automation

- 6 AI, Automation, MES, CNC and PLC Boundaries
- 7 Safe Prompting and Data Handling
- 8 QR and Mobile Data Capture
- 9 Workflow Automation and Alerts
- 10 AI-Assisted Daily Meeting

DAY 6

AI, Automation, MES, CNC and PLC Boundaries

We add tools that can help — and first learn where they must stop. Today is about boundaries, not technology.

TODAY'S DELIVERABLE · AI Use-Case Register (allowed, restricted, prohibited).

THE HOSPITAL PICTURE

The assistant who reads charts and writes a summary is like AI — helpful, but can be wrong. The heart-monitor alarm that calls a nurse is like automation — a fixed rule. The ventilator is the machine controller. Nobody lets the chart assistant adjust the ventilator.

Term	Plain meaning	Factory example
Automation	A fixed rule that acts automatically when something happens	A safety hold is recorded → a message goes to supervisor and HSE
AI assistant	Reads approved information and drafts summaries or options — it can be wrong, so its output is only a draft	Summarizing yesterday's downtime into five lines
MES / ERP	Systems that record what is happening and carry controls the factory already requires	Job status, quantities and orders in a controlled system
CNC controller	Runs the machine's cutting or bending program	L2 running a nesting program
PLC / HMI / interlock	Controls machine sequences, operator panels and safety circuits	A guard interlock that stops a press brake when opened

THE BOUNDARY

Information side — dashboards, trackers, reports, AI summaries (may help). **Machine-control side** — CNC controllers, PLCs, HMIs, interlocks, safety circuits, extraction, ovens (AI must never change these).

Allowed, restricted, prohibited

ALLOWED — AI ASSISTS

- Summarize orders, shortages, downtime, defects, handovers
- Draft status updates, reports, meeting questions
- Suggest schedule options for review
- Flag at-risk orders and repeat failures

PROHIBITED — NEVER DELEGATED

- Commanding CNC, PLCs, HMIs, interlocks, extraction, ovens
- Approving delivery dates or material substitutions
- Approving inspection results
- Maintenance diagnosis or production restart

RESTRICTED — ONLY WITH CONDITIONS

Needs an approved tool, a defined set of approved data, a named reviewer and a recorded decision. Examples: connecting an AI tool to dashboard data; using AI on anything touching customer, employee or pricing information.

#	Proposal	Class	Why
1	Summarize yesterday's downtime from approved dashboard data	ALLOWED	Information only; supervisor reviews
2	Draft a follow-up message to the steel supplier	ALLOWED	

#	Proposal	Class	Why
			Draft only; Procurement approves commitment
3	Suggest options for the L2 overload	ALLOWED	Options only; supervisor and engineering approve
4	Read-only AI tool connected to the dashboard	RESTRICTED	Needs approved tool, access control, named reviewer
5	Paste a customer drawing into a public AI chat	PROHIBITED	Confidential drawing must not go to a public AI system
6	AI changes the CNC program on L2 automatically	PROHIBITED	AI never changes machine controllers or programs
7	AI tells BR3 operators it is safe to restart	PROHIBITED	Restart needs designated human authorization
8	AI-generated delivery date sent to a customer	PROHIBITED	AI cannot approve delivery dates

DAY 6 — PROFESSIONAL LESSON

A weak supervisor: "The AI said it is fine, so restart the machine."

A professional supervisor: "The AI prepared a draft. Quality, maintenance and the authorized person decide, and I record the decision."

AI prepares an option. The supervisor approves or rejects it.

DAY 7

Safe Prompting and Data Handling

A prompt is the instruction you give an AI assistant. A careless prompt can leak confidential information; a vague prompt gives a vague answer.

TODAY'S DELIVERABLE · Prompt Library built from approved shift data.

Never put into a public AI tool

NEVER SHARE

- Confidential drawings · CNC files · machine configurations
- Order and job numbers · machine codes
- Customer data and names
- Passwords and access details
- Pricing · employee data

SAFE APPROVED SHIFT DATA

- Planned and actual quantities
- Job and hold statuses
- Downtime minutes and standard reasons
- Counts of orders at risk

PUBLIC AI VS APPROVED INTERNAL AI

The example prompts in this manual (which reference identifiers such as G-103, L2 or BR3) assume an **approved, governed internal AI tool** operating on approved shift data. Never paste real job numbers, machine codes, customer names, drawings, pricing or CNC files into a **public** AI tool. The "never share" list above always applies to public AI.

The five-part prompt

Part	Question it answers	Example
1 • Role	Who should the AI act as?	"You are a production-reporting assistant"
2 • Data	What approved facts are supplied?	L2 downtime 90 min; G-103 due tomorrow; BR3 on quality hold
3 • Task	What exactly do you want?	"Write a five-line morning briefing"
4 • Limits	What must it not do?	"Do not give delivery dates or diagnoses; list missing information"
5 • Label	How must it mark the answer?	Start with: Draft — Human Review Required

WEAK PROMPT

"What should I do about production today?" — no facts, no limits, no format; the answer will be guesswork.

STRONG PROMPT

"You are a production-reporting assistant. Using only this data — L2 down 90 min, BR3 on quality hold, G-103 due tomorrow — write a five-line briefing. Do not give delivery dates or diagnoses. List missing information. Start with: Draft — Human Review Required."

Spot the problems

A trainee types: "Here is the full drawing of the ABC Power canopy, our price of AED 48,000, and the tracker password. Tell me the delivery date to promise and adjust the L2 CNC settings to run faster."

#	Problem	Rule broken
1	Full drawing pasted	No confidential drawings in public AI
2	Customer name	No customer data
3	Price	No pricing
4	Password	No passwords or access details
5	Asks AI to promise a delivery date	AI cannot approve delivery dates
6	Asks AI to change CNC settings	AI never changes machine configurations

DAY 7 — PROFESSIONAL LESSON

A weak supervisor: "I pasted everything in so the AI has full information."

A professional supervisor: "I give the AI only approved facts, clear limits and a label, and I check every answer."

Careful prompts protect the factory; careful review protects the decision.

DAY 8

QR and Mobile Data Capture

Day 3 showed that automation fails without accurate data. Today we build the way operators give that data quickly and correctly: a QR code on the job and a short form on a mobile device.

TODAY'S DELIVERABLE · Production Update System — machine, job, quality, safety, maintenance and material forms.

THE SUPERMARKET PICTURE

The scanner reads the code and the till records it instantly. In the factory the QR identifies the job and machine; the operator taps what happened; the tracker updates. Nobody has to phone or write it down later.

FIVE RULES FOR A GOOD FORM

- **Few fields** — an operator should finish in seconds.
- **Drop-down lists, not free text** — use the standard downtime reasons from Day 3.
- **Validated codes** — job and machine codes checked against the master list.
- **Required fields cannot be skipped.**
- **Duplicate entries controlled** — scanning twice must not count twice.

Form	Core fields
Job update	Date, shift, job number, machine code, operator ID, start/finish, good quantity, scrap quantity, next operation
Downtime	Job, machine, start/finish, downtime minutes, standard reason
Quality	Job, machine, inspection status, hold reason, quantity affected
Safety	Machine, safety hold or near-miss, description, reported by
Maintenance request	Machine, symptom, production effect, urgency
Material	Job, material, shortage or issue, location, quantity

The pilot and a worked example

Start small: one laser (L1), one press brake (BR1), one product family (canopy doors), one shift, a small group of trained operators, with paper remaining as fallback. Success = operators update quickly, duplicates controlled, codes validated, supervisors see current status, paper fallback available.

Operator scans job QR

Selects Quality hold

Reason: repeated bend-angle rejection

Quantity affected: 4

Tracker updates

S

The system records the event. It does not decide how BR3 is repaired or whether restart is safe.

Test entry	Expected result
Correct job and machine	Accepted
Wrong machine code (e.g. L9)	Rejected — code not in master list
Same update scanned twice	Second entry blocked or flagged
Required field left blank	Cannot submit
Quality hold entered	Supervisor and quality notified; job not shown ready

DAY 8 — PROFESSIONAL LESSON

A weak supervisor: "We'll type it into the system at the end of the shift."

A professional supervisor: "The operator records the update at the machine, and I see the current status now."

Data captured at the moment of work is data you can trust.

DAY 9

Workflow Automation and Controlled Alerts

Once updates arrive reliably, we route them automatically so the right person hears about the right problem at the right time. The goal is fewer, better alerts — not more noise.

TODAY'S DELIVERABLE · Workflow v1 — controlled alerts routed to department owners.

THE FIRE-ALARM PICTURE

A smoke detector senses a condition (trigger), sounds for the right people (recipient), the fire warden acts (owner), and if nothing happens the alarm escalates until the event is closed. A detector that rings for toast every day is ignored when there is a real fire — that is alert fatigue.

Every alert defines six things:



Alert trigger	Typical owner (guidance example)
Safety hold recorded	HSE and supervisor
Breakdown exceeds escalation limit	Maintenance
Job not started by planned time	Supervisor / planning
Actual quantity below plan	Supervisor
Shortage affects a priority order	Stores / Procurement
First-off inspection pending	Quality
NCR or rework assigned	Quality
Drawing revision changes after job release	Engineering
Preventive maintenance overdue	Maintenance
Order approaching delivery-risk threshold	Planning / management

ALERT FATIGUE

Avoid alerts for minor events that need no action. The rule: if nobody must act, it should not be an alert — put it on the report instead.

CASE — G-103 HAS NOT STARTED

G-103 (15 base-frame brackets) is due tomorrow. Planned start 8:00; at 8:20 no start recorded on L2. **Trigger:** job not started by planned time (critical). **Recipient:** supervisor and planner. **Owner:** supervisor. **Response:** check readiness (drawing, material, program, operator, hold); start or record reason. **Escalation:** if unresolved within the factory limit → production manager. **Closure:** job running, or hold recorded with owner and time.

DAY 9 — PROFESSIONAL LESSON

A weak supervisor: "Send everyone every notification so nobody misses anything."

A professional supervisor: "Send the right alert to the owner, define the response and escalation, and close it with a record."

An alert that nobody must act on should not exist.

DAY 10

The AI-Assisted Daily Meeting and Report

The dashboard data feeds an AI draft briefing, and the supervisor reviews it before the meeting. The AI saves preparation time; the supervisor owns the content.

TODAY'S DELIVERABLE · Daily Report Template.

Dashboard data › AI draft briefing › Supervisor review & correction › Meeting › Named actions & deadlines › Report approved

TEN-ITEM MEETING STRUCTURE

1. Safety exceptions
2. Previous-shift plan vs actual
3. Priority orders
4. Machine breakdowns
5. Material shortages
6. Quality holds
7. Engineering issues
8. Maintenance actions
9. Dispatch risks
10. Named actions and deadlines

THE REPORT TEMPLATE RECORDS

- Data period (shift or day)
- Data source (dashboard / tracker)
- Last refresh time
- Missing-data warning
- AI label: Draft — Human Review Required
- Reviewer and approval date
- Final decision or action

Case study — review the AI draft

APPROVED DATA

Plan attainment 91.5% (430 of 470) · Downtime 170 min · Scrap 3.2% · Orders at risk 5 · BR2 quantity not entered

AI Draft: "The shift achieved 94% of plan with downtime of 70 minutes and scrap of 3.2%. Three orders are at risk. All machines reported."

Statement in the draft	Checked against data	Correction
94% of plan	$430 \div 470 \times 100 = 91.5\%$	Change to 91.5% (needs attention)
Downtime 70 minutes	Data says 170 minutes	Change to 170 minutes
Scrap 3.2%	Matches	Keep
Three orders at risk	Data says five	Change to five
All machines reported	BR2 quantity missing	Replace with a missing-data warning for BR2

The supervisor found four errors in a five-sentence draft. The AI organizes; the supervisor verifies. A briefing that ends without named actions and deadlines is only a discussion.

DAY 10 — PROFESSIONAL LESSON

A weak supervisor: "The AI report looks good, so I'll read it out."

A professional supervisor: "I checked every number against the dashboard, corrected the draft, and left the meeting with named actions."

The report is only as good as the review behind it.

04

PART FOUR • DAYS 11-15

Professional Implementation

- 11 Intelligent Scheduling
- 12 Maintenance and Downtime Intelligence
- 13 Quality, Safety and Traceability
- 14 Cybersecurity and AI Governance
- 15 Capstone Simulation

DAY 11

Intelligent Scheduling

Because Days 2–10 gave you reliable capacity, travelers, KPIs, QR updates and alerts, we can now use rules and AI to prepare schedule options. The supervisor still chooses.

TODAY'S DELIVERABLE · Approved Schedule Board.

THE AIR-TRAFFIC-CONTROL PICTURE

A controller does not land planes in the order they call — each has fuel, distance, runway and weather, and an emergency is handled first, not by score. In scheduling, the score proposes the order; hard restrictions and people keep it safe.

Hard restrictions and a simple scoring example

HARD RESTRICTIONS — SCORE ZERO / EXCLUDED

Safety hold · quality hold · unreleased drawing · missing material · unapproved process deviation · missing required tooling or program · no authorized operator where authorization is mandatory. No score, however urgent, can override these.

Job (0–3 each)	Due-date urgency	Customer priority	Readiness	Score
G-103 (due tomorrow, Critical, ready)	3	3	3	9
G-102 (3 days, High, ready)	2	2	3	7
G-101 (5 days, Normal, ready)	1	1	3	5
G-105 (material hold)	—	—	—	0 • excluded

Guidance example only: your factory chooses its own elements, scales and weights and records them before scoring is used.

Schedule options A–D on the Day 2 data

L2 has 420 available minutes; G-101 needs 300, G-102 needs 180, G-103 needs 120 (total 600). G-101 approved for L1, L2, L3; G-102 for L2 and L3; G-103 for L2 only. L1 has 200 free minutes; L3 has 220.

Option	Idea	Result with these numbers
A • Protect urgent delivery	G-103 first on L2; G-102 to L3; G-101 on remaining L2 time	L2: $120 + 300 = 420$ (100%) · L3: 180 of 220 (81.8%) — urgent order safe but L2 has no slack
B • Minimize setups	No job split between machines	Same assignment as A here — when options agree, the decision is easier
C • Balance machine load	Split G-101: 200 min L1, 100 min L2	L2: $120 + 100 = 220$ (52.4%) · L1: 200 of 200 (100%) · L3: 180 of 220 — adds a second setup
D • Recover delayed orders	If an order is already late, sequence it first	G-102 already behind → starts first on L3; G-103 and G-101 follow on L2

BEFORE APPROVING ANY OPTION

Check the next operation (for example bending capacity), the extra setups, material, programs, operators, and engineering approval for any alternative machine. A schedule that floods bending only moves the queue.

DAY 11 — PROFESSIONAL LESSON

A weak supervisor: "The software scheduled it, so it's fine."

A professional supervisor: "The tool proposed options; I checked restrictions, loads and the next operation, and I approved one."

The supervisor selects, modifies or rejects the recommendation.

DAY 12

Maintenance and Downtime Intelligence

Today we turn recorded downtime into patterns the supervisor can act on, and hand the technical work to Maintenance where it belongs.

TODAY'S DELIVERABLE · Maintenance Intelligence Pack.

THE CAR-DASHBOARD PICTURE

A warning light does not tell you the failed part; it tells you where to look. Downtime analysis is the same — it shows the supervisor where the losses are and who should investigate. Maintenance diagnoses and repairs.

The downtime Pareto

A Pareto ranks causes from largest to smallest so you fix the biggest first. Example week for one area (200 minutes total):

Reason	Minutes	% of total	Cumulative %
Breakdown	90	45%	45%
Setup	50	25%	70%
Material shortage	30	15%	85%
Waiting for inspection	20	10%	95%
Tool change	10	5%	100%
Total	200	100%	

Breakdown and setup together are 70% of lost time; the top three reasons are 85%. Start with breakdowns (owner: Maintenance) and setup (owner: supervisor and planning). This only works if reasons are the standard codes from Day 3 — "machine problem" cannot be ranked. **% of total = reason minutes ÷ total minutes × 100** (e.g. $90 \div 200 \times 100 = 45\%$).

PM tracker and failure history

PM compliance = PM tasks completed on time ÷ PM tasks due × 100 (e.g. $18 \div 20 \times 100 = 90\%$). Overdue PM raises an alert to Maintenance. Repeated events on the same machine are flagged for review — for example L2 with three nozzle-change stops in a week, or BR3 with repeated bend-angle rejection.

CASE — L2 STOPS AGAIN

L2 recorded three nozzle-change stops this week, 20 minutes each, plus one 40-minute stop with no reason entered. Total known stops: $3 \times 20 = 60$ minutes; add the 40-minute stop = **100 minutes** of L2 downtime. Flag the 40-minute stop as missing data; report the repeat pattern to Maintenance (do not diagnose); record owner and date; check whether the stoppage alert fired; tell planning the effect on L2 capacity.

PREDICTIONS ARE RISK INDICATORS

Repeated-failure indicators, abnormal cycle-time alerts and PM effectiveness are risk indicators, not confirmed diagnoses.

DAY 12 — PROFESSIONAL LESSON

A weak supervisor: "L2 keeps breaking — it must be the laser tube."

A professional supervisor: "L2 has a repeating pattern of stops. I've reported it with the minutes and reasons; Maintenance will diagnose."

The supervisor reports the production effect; Maintenance finds the technical cause.

DAY 13

Quality, Safety and Traceability

Speed means nothing if the product is wrong or someone is hurt. Today you build the records that let you stop bad work, protect people and trace every part.

TODAY'S DELIVERABLE · Quality/HSE Control Pack.

THE FOOD-RECALL PICTURE

A good food company can say which boxes, which day, which line. A factory with good records can do the same for a bend-angle defect: which job, which machine, which material, which operator, which inspection. That ability is traceability.

Hold	Raised by	Cleared by
Quality hold	Operator or inspector	Quality
Safety hold	Anyone	HSE / authorized person
Engineering hold	Operator or supervisor	Engineering
Material hold	Stores or operator	Stores / Procurement
Maintenance hold	Operator or supervisor	Maintenance

TRACEABILITY CHAIN

Job number → drawing revision → material grade and batch → machine → operator → inspection records → hold or release. If any link is missing, the supervisor cannot answer "which parts are affected?"

Numbers, safety rules and the BR3 case

First-pass yield and rework rate: 60 parts inspected, 54 passed without rework, 6 needed rework. First-pass yield = $54 \div 60 \times 100 = 90\%$; rework rate = $6 \div 60 \times 100 = 10\%$.

BR3 case: 10:15 — BR3, job G-101, repeated bend-angle rejection, 4 parts affected. Place on quality hold; isolate parts; notify quality, maintenance, engineering and supervisor; check first-off record, tooling, setup, drawing revision, material and program; redirect only to a validated alternate route; restart only with human authorization and recorded release evidence.

SAFETY RULES THAT NEVER BEND

No digital status overrides a physical safety condition · a safety hold removes the job from the ready-to-run list · only authorized personnel operate machines · LOTO is required where the site energy-control procedure applies · near misses and guarding defects are recorded and investigated · restart requires designated human authorization · powder coating: never compromise ventilation, grounding, housekeeping, fire prevention or colour-change checks to save time.

DAY 13 — PROFESSIONAL LESSON

A weak supervisor: "Push the urgent parts through; we'll sort quality later."

A professional supervisor: "The job is on hold. I know which parts, which machine and which inspection — and who clears it."

A job on hold does not continue because the date is urgent.

DAY 14

Cybersecurity and AI Governance

A connected factory gains visibility — and exposure. Today you set up the controls that keep production data, programs and machines safe, and the log that keeps AI honest.

TODAY'S DELIVERABLE · AI/OT Governance Pack.

THE FACTORY-GATE PICTURE

Visitors sign in, keys are signed out, and the office is separate from the workshop. Cybersecurity is the digital version: identity (who are you), access (what may you do), separation (office IT apart from machine OT), logs (what happened) and backups (can we recover).

THE CONTROLS

- Separate office IT, dashboard services and machine OT where practical; no uncontrolled AI-to-machine connectivity.
- Role-based access; individual accounts and strong authentication.
- Control and scan USB devices; log and supervise vendor remote access.
- Back up data, programs, configurations and critical documents; test the manual fallback and restoration.

Role	View	Enter updates	Approve release	Edit master data	Remote access
Operator	Yes	Yes	No	No	No
Supervisor	Yes	Yes	Yes	No	No
Planner	Yes	Yes	Per authority	Limited	No
Maintenance	Yes	Yes	No	No	Controlled
Vendor	No	No	No	No	Logged & supervised

Example only: IT/OT and management set the real permissions.

TWO SITUATIONS

A • Unknown USB on the L1 workstation: do not use it; keep safety first; report to IT/OT and supervisor; record time and location; follow the cyber-incident process. **B • Vendor phones for a password to remote in and fix BR1:** never share passwords; vendor access goes through the approved, logged and supervised remote-access process; a named person approves.

CYBER-INCIDENT RESPONSE CARD

Keep people and machines safe first — safety overrides everything. Do not try to fix or investigate it yourself. Report immediately to IT/OT and your supervisor using the cyber-incident process. Record time, what you saw, device and user. Follow IT/OT instructions; use the manual fallback if the system is not trusted.

DAY 14 — PROFESSIONAL LESSON

A weak supervisor: "It's easier to share one login so everyone can update the board."

A professional supervisor: "Everyone has an individual account with role-based access, and I can prove who did what."

Convenience must never create unsafe dependence on the system.

DAY 15 • CAPSTONE

Capstone Simulation: Three Orders Under Disruption

Everything now comes together. You run three orders through the full eight-department workflow while the factory throws problems at you. No new theory today — only decisions, records and ownership.

TODAY'S DELIVERABLE · Final dashboard and SOP pack with the supervisor's decision log.

Item	Detail
G-101	10 generator canopy sets, due in five days
G-102	6 control-panel enclosures, due in three days
G-103	15 urgent base-frame brackets, due tomorrow
Disruption 1	L2 unavailable for two hours
Disruption 2	BR3 produces repeated angle defects
Disruption 3	PC1 is set for a different colour from the urgent order

Safety and holds first

Protect the urgent order

Recalculate capacity

Check the next operation

Approve and record

Communi

Disruption 1 — L2 is down for 2 hours

Step	Calculation / action	Result
1 • Capacity left on L2	$420 - 120$	300 min
2 • Protect G-103 (L2-only)	120 min on L2	180 min left on L2
3 • G-102 (approved L2, L3)	180 min on L3 (220 free)	L3: 180 of 220 = 81.8%
4 • G-101 300 min (approved L1, L2, L3)	160 min on L1 (200 free) + 140 min on L2	L1: $80\% \cdot L2$: $120 + 140 = 260$ of 300 = 86.7%
5 • Check	$160 + 140 = 300$ ✓	No machine over 87%

Actions around the numbers: stop assigning new work to L2 and record breakdown time and job status; notify maintenance and planning; confirm programs, material, operators and engineering approval for the L1 and L3 moves; check bending capacity before releasing extra cut parts; recalculate expected completion for each order; record the supervisor's approved recovery decision. Ask engineering to assess plasma or shearing alternatives only where technically appropriate — never switch process just because a laser is busy.

Disruptions 2 and 3 — BR3 defects and the colour conflict

BR3 BEND-ANGLE DEFECTS

1. Place affected work on quality hold; stop further processing until reviewed.
2. Identify the affected jobs and quantities.
3. Notify quality, maintenance, engineering and supervisor.
4. Review tooling, setup, drawing revision, material, program and first-off records.
5. Redirect only work with a validated alternate route — for the canopy door, BR1, BR2, BR4 and BR5.
6. Record inspection and release evidence before BR3 restarts.

PC1 COLOUR CONFLICT

1. List all jobs that need the current colour.
2. Compare colour-change time and cleaning against due-date risk.
3. Confirm whether the urgent order truly needs coating immediately.
4. Group compatible work without overriding delivery.
5. Obtain supervisor approval for the final sequence.
6. Record booth cleaning, grounding, ventilation, housekeeping and colour-change checks.

Issue	Decision	Approved by
L2 down for 2 hours	G-103 stays on L2; G-102 to L3; G-101 split L1 / L2	Supervisor (engineering approval where needed)
BR3 angle defects	Quality hold; reroute canopy-door work to BR1 / BR2 / BR4 / BR5 if validated	Quality / supervisor
PC1 colour conflict	Sequence approved after comparing changeover and due dates	Supervisor

FINAL LESSON OF THE PROGRAMME

The system you built is a tool for the supervisor — not a replacement. AI assists with planning, visibility, analysis and reporting; authorized people retain operational, technical, quality, safety and delivery authority. Follow the order through the process, find the real restriction, assign an owner, verify the result — and keep the records that prove it.

DAY 15 • ASSESSMENT

Capstone Assessment Criteria

Criterion	What good looks like
Safety and quality first	Holds placed before delivery decisions
Correct numbers	Capacity and KPI arithmetic checked
Ownership	Every issue has an owner, deadline and status
Approvals	Alternatives and process changes approved by the right person
AI use	Every AI output labelled, reviewed and logged
Records	Decisions and evidence complete and traceable

Present your decision log and final dashboard. Submit the Day-15 deliverable pack (see the Reference section) and a capstone report with lessons learned.

05

PART FIVE

Reference & Appendix

- R1** Required Data Structure
- R2** Supervisor Dashboard Design
- R3** Capstone Decision Model
- R4** Safety, AI & Cybersecurity Non-Negotiables
- R5** Final Day-15 Deliverable Pack
- A** Forms, Checklists & Templates

REFERENCE • R1

Required Data Structure

MASTER TABLES

- Machine
- Employee and authorization
- Department
- Product and part
- Routing
- Downtime-code
- Defect-code
- Material
- Supplier
- Customer-order
- Approved AI-tool register
- OT asset register

TRANSACTION TABLES

- Production orders
- Job travelers
- Operator updates
- Material receipts and issues
- Inspections
- NCR and rework
- Downtime
- Maintenance work
- Safety observations
- AI recommendations and approvals
- Dispatch transactions

MANDATORY PRODUCTION FIELDS

- Date and shift
- Order, job and customer code
- Part number and description
- Drawing number and revision
- Planned quantity
- Actual good, scrap and rework quantity
- Machine code and operator ID
- Start and finish time
- Downtime minutes and reason
- Material, first-off, safety and quality status
- Current and next operation
- Job status, action owner, supervisor approval

REFERENCE • R2

Supervisor Dashboard Design

Row	Contents
Top — Immediate control	Safety holds · Quality holds · Machines down · Orders at risk · Material shortages · Jobs waiting for engineering
Middle — Shift performance	Plan vs actual · Good quantity · Scrap and rework · Downtime · First-pass yield · On-time operation completion
Lower — Forward risk	Jobs due next period · Jobs not ready for release · Overloaded work centers · Missing bought-out parts · Powder-colour conflicts · Overdue maintenance · Open corrective actions

The action panel records: Issue · Affected job · Department · Owner · Required action · Target · Status.

RULE

Every red indicator must create or link to an assigned action. A red chart without an owner is only decoration.

REFERENCE • R3

Capstone Decision Model

Situation	Decision sequence
L2 breakdown	Stop assigning new work to L2 · record breakdown time and job status · notify maintenance and planning · identify work that can run on L1 or L3 without unapproved process changes · ask engineering to assess plasma or shearing alternatives where technically appropriate · recalculate expected completion · record the approved recovery decision.
BR3 bend-angle defects	Place affected work on quality hold · stop further processing until reviewed · identify affected jobs and quantities · notify quality, maintenance, engineering and supervisor · review tooling, setup, drawing revision, material, program and first-off records · redirect only validated alternate routes · record inspection and release evidence before restarting.
Powder-colour conflict	Identify all jobs requiring the current colour · compare changeover impact against due-date risk · confirm whether the urgent order truly requires immediate coating · group compatible work without overriding delivery · obtain supervisor approval for the final sequence · record booth cleaning, grounding, ventilation, housekeeping and colour-change checks.

REFERENCE • R4

Safety, AI & Cybersecurity Non-Negotiables

SAFETY

- No digital status overrides a physical safety condition
- A safety hold removes the job from the ready-to-run list
- Only authorized personnel operate machines
- LOTO required where the site energy-control procedure applies
- Near misses and guarding defects recorded and investigated
- Restart requires designated human authorization

AI GOVERNANCE

- Every AI recommendation marked Draft — Human Review Required
- Record input data, recommendation, reviewer, decision and result
- No public AI for confidential drawings, customer data, passwords, pricing, employee data, CNC files or machine configurations
- AI cannot approve delivery dates, material substitutions, inspection results, maintenance diagnoses or production restart

CYBERSECURITY

- Separate office IT, dashboard services and machine OT where practical
- No uncontrolled AI-to-machine connectivity
- Role-based access; individual accounts and strong authentication
- Control and scan USB devices
- Log and supervise vendor remote access
- Back up data, programs, configurations and documents; test restoration
- Escalate suspicious behaviour via the cyber-incident process

REFERENCE • R5

Final Day-15 Deliverable Pack

Each trainee submits all 24 items.

#	Deliverable	#	Deliverable
1	Eight-department process map	13	LOTO verification register
2	Department RACI and escalation matrix	14	Powder-coating safety checklist
3	Machine and capacity register	15	OT asset register
4	Digital job traveler	16	Network-separation diagram
5	Job-readiness checklist	17	Approved USB and remote-access register
6	QR production-update form	18	Cyber-incident response card
7	Daily production dashboard	19	Manual production fallback procedure
8	Production scheduling board	20	AI governance and decision register
9	Downtime Pareto and PM tracker	21	Prompt library
10	NCR and rework log	22	Daily meeting and shift-handover templates
11	Safety inspection checklist	23	Departmental SOP pack
12	Near-miss and incident form	24	Capstone report with lessons learned

APPENDIX

Forms, Checklists & Templates

JOB-READINESS CHECKLIST

Check	Yes	No	Owner / note
Correct drawing revision available	☐	☐	
Material physically available	☐	☐	
CNC program / work instruction available	☐	☐	
Machine available	☐	☐	
Correct tooling available	☐	☐	
Authorized operator available	☐	☐	
Safety requirements satisfied	☐	☐	
First-off inspection planned	☐	☐	
Next operation ready	☐	☐	
Job priority approved	☐	☐	
Status visible to all departments	☐	☐	

AI DECISION LOG

Date	Input data	AI recommendation (Draft)	Reviewer	Final decision	Result

HOLD-POINT REGISTER

Hold type	Job / order	Reason	Raised by	Authorized to clear	Time raised	Time cleared
Engineering						
Material						
Quality						
Safety						
Maintenance						

BOTTLENECK EVIDENCE SHEET

Process • Queue length • Waiting time • Available capacity •
Output • Downtime • Jobs affected • Delivery impact.

SUPERVISOR ACTION LIST

Problem • Order • Department • Owner • Required action • Target •
Status.

PREPARED BY

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AI supports planning, visibility, analysis, and reporting. Authorized personnel retain operational, technical, quality, safety, cybersecurity, and delivery authority.