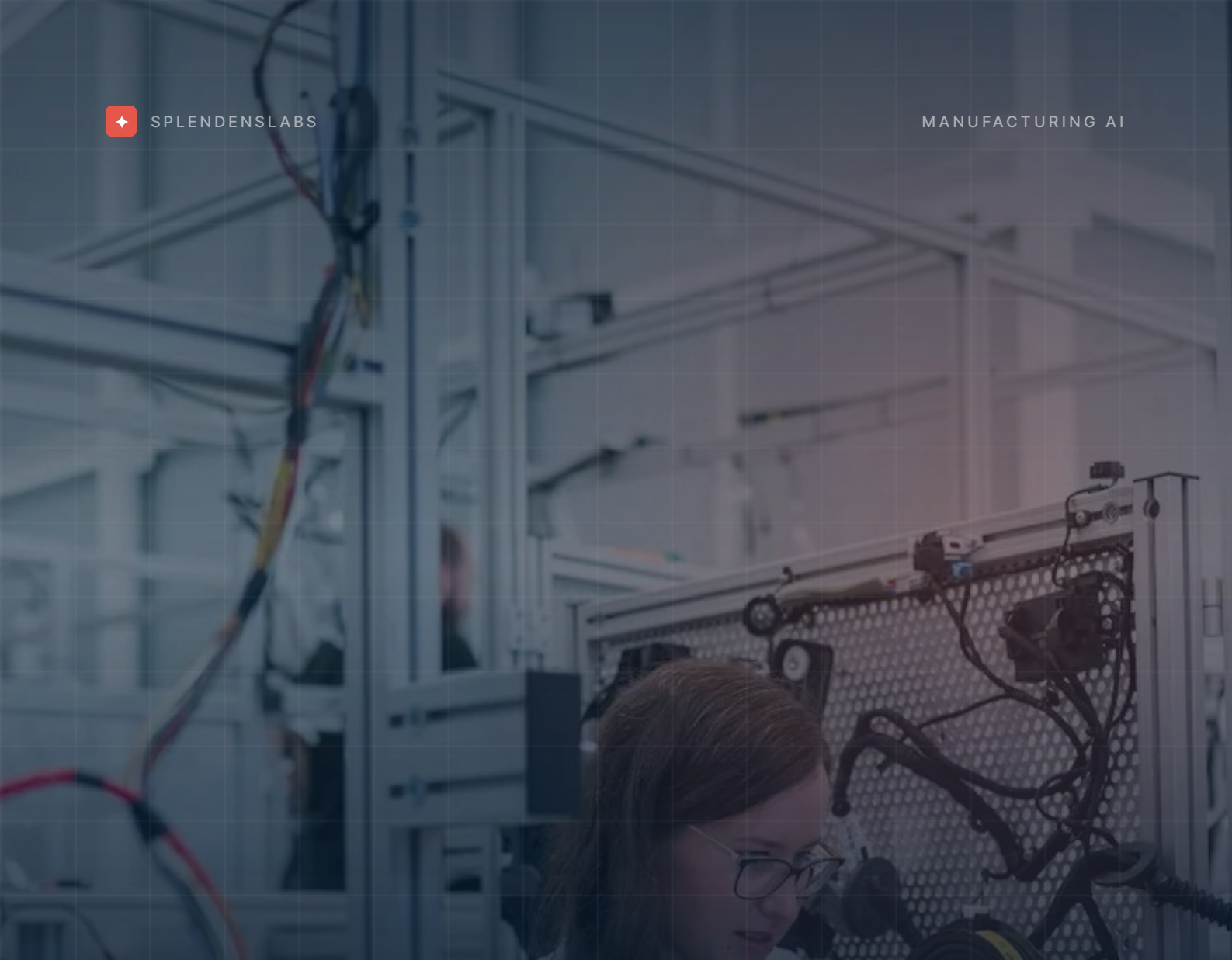


✦ GUIDE · MANUFACTURING AI

Manufacturing AI Industry Guide

Quality inspection, predictive maintenance, shop-floor SOP assistants and supply chain intelligence — with the OT/IT integration and safety discipline that factories demand.

FORMAT	LEVEL	READ TIME	UPDATED
Guide	Intermediate	16 min	Oct 2026

OVERVIEW

What this guide covers

Factories already produce the data AI needs — sensor streams, inspection images, maintenance logs, SOPs and ERP transactions — but it is scattered across machines, historians and spreadsheets. This guide covers the use cases that tend to pay back, a reference architecture that respects the boundary between operational and enterprise networks, the security and safety standards to design for, a way to estimate ROI from your own baseline, and a phased plan from one line to many plants.

KEY TAKEAWAYS

- Start where a defect, a breakdown or a search for information has a clear, measurable cost.
- Keep AI advisory on the shop floor; safety functions stay with certified control systems.
- Respect the OT/IT boundary — read from operations through secure, one-way paths wherever possible.
- SOP assistants must answer from the controlled, current revision and cite it.
- Prove value on one line with a measured baseline before scaling across plants.

WHO IT'S FOR

- Plant heads and operations leaders
- Quality and maintenance managers
- Manufacturing IT / OT teams
- Digital transformation leads

HOW TO USE IT

Pick a starting use case in section 01, align IT and OT teams on 02–03, then use the ROI table and phased plan to build the business case.

CONTENTS

01 High-value use cases
02 Reference architecture
03 Security, safety and compliance
04 An ROI model framework
05 A phased implementation plan
06 Pitfalls to avoid

01 / USE CASES

High-value use cases

The best first projects target a known, costly problem on a specific line, with data that already exists or can be captured cheaply.

QUALITY

Visual inspection

Cameras and vision models flag surface defects, misassemblies and labeling errors for an inspector to confirm.

MAINTENANCE

Predictive maintenance

Vibration, temperature and current data detect early signs of failure and open work orders ahead of breakdowns.

KNOWLEDGE

SOP and troubleshooting assistant

Operators ask questions in their own language and get answers from the current SOPs and manuals, with citations.

SUPPLY CHAIN

Demand and material planning

Forecasts demand and flags material shortages and supplier delays for planners.

QUALITY

Root-cause analysis support

Summarizes process data, deviations and past CAPAs around a defect for the quality engineer.

DOCUMENTS

Document automation

Extracts data from supplier certificates, invoices and inspection reports into ERP and QMS.

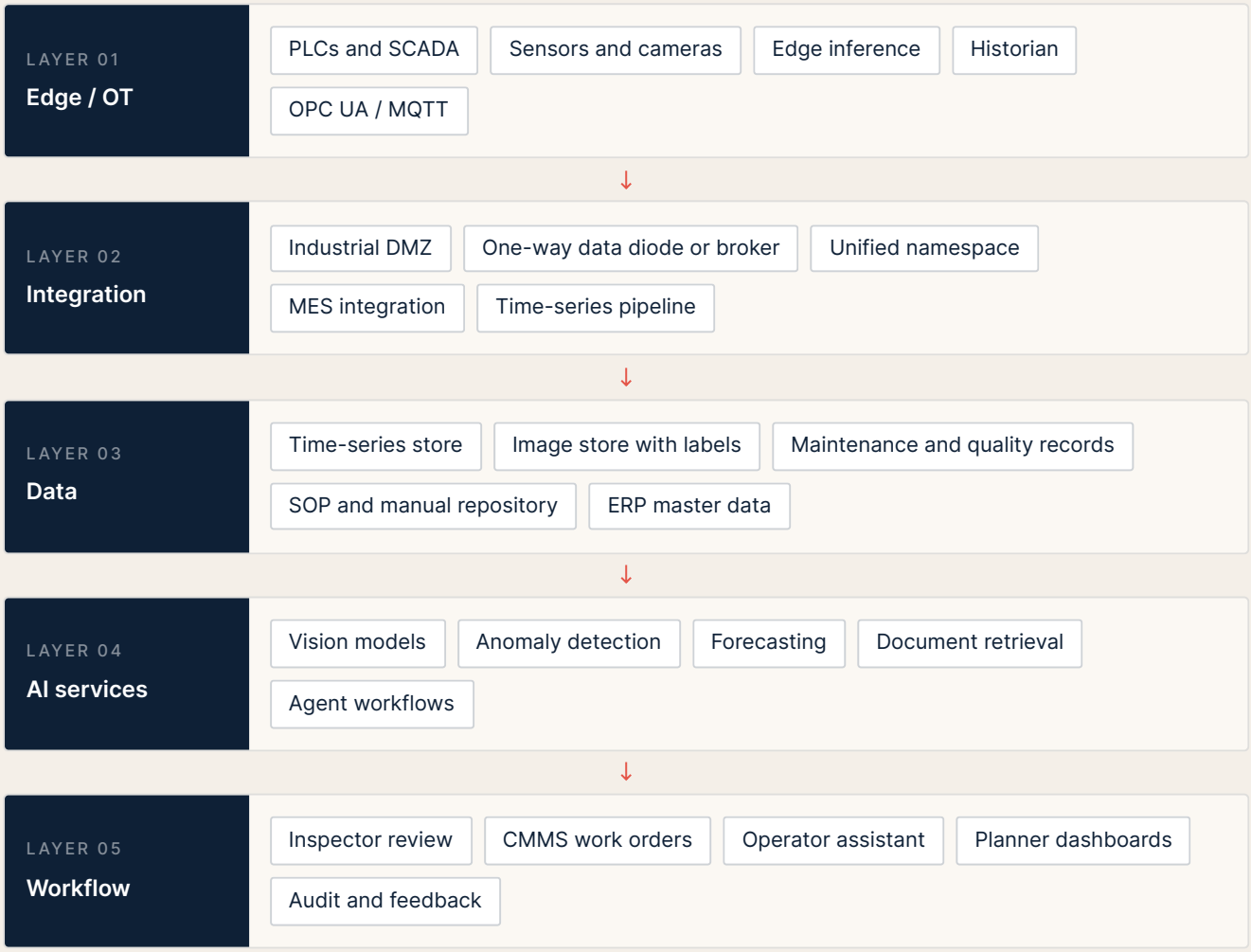
Choosing a first project

USE CASE	DATA NEEDED	MAIN RISK	GOOD FIRST PROJECT?
SOP assistant	Controlled SOPs and manuals	Outdated revisions	Yes — fast and low risk
Visual inspection	Labeled images of good and defective parts	Too few defect samples	Yes, on one station
Predictive maintenance	Sensor history with failure records	Few recorded failures	If sensor history exists
Demand planning	Sales, orders and lead times	Planners ignore forecasts	After data cleanup

✦ 02 / ARCHITECTURE

Reference architecture

Manufacturing AI spans two worlds. Operational technology runs machines in real time; IT runs planning and analytics. The architecture keeps them connected without exposing the plant floor.



From sensor signal to work order



Run latency-critical inference, such as inline inspection, at the edge so the line does not depend on a cloud connection. Send aggregated data and model outputs upward for analytics and retraining, following the ISA-95 levels your plant already uses.

03 / COMPLIANCE

Security, safety and compliance

In a factory, an AI error can stop a line or hurt someone. Security and functional safety come before features.

SECURITY

IEC 62443

The industrial automation security standard series; use its zones and conduits model to place AI components.

INTEGRATION

ISA-95

A common model for enterprise–control integration that helps define where AI services sit and what they may touch.

QUALITY

ISO 9001 and sector standards

AI-assisted inspection and document changes must fit your QMS, including IATF 16949 in automotive.

REGULATION

EU AI Act and Machinery Regulation

AI that acts as a safety component of machinery sold in the EU may be classed as high-risk.

SAFETY

AI advises; certified systems protect

Never place an AI model in a safety function such as interlocks, emergency stops or guarding. Those stay with certified safety controllers. AI may recommend actions, but changes to machine setpoints need a human, an approved procedure and, where required, a management-of-change review.

- Worker safety law applies to any AI-guided task — for example, the Factories Act 1948 in India or OSHA rules in the US. AI guidance must not contradict approved safety procedures.
- Camera systems that capture workers raise privacy obligations under the DPDP Act 2023 or GDPR; position cameras on parts, not people, wherever possible.
- Protect process recipes and design data as trade secrets; confirm that model providers do not retain or train on them.

✦ 04 / BUSINESS CASE

An ROI model framework

Manufacturing has well-understood cost drivers. Measure the baseline on the target line for a few weeks, then estimate each driver and validate it in the pilot.

DRIVER	FORMULA	BASELINE TO MEASURE
Scrap and rework	Units per month × change in defect escape rate × cost per defect	Current defect and escape rates by type
Unplanned downtime	Downtime hours avoided × contribution margin per line hour	Downtime log by cause and asset
Maintenance cost	Change in emergency repairs × (emergency cost − planned cost)	Repair history and spare-part spend
Operator time	Searches per shift × minutes saved × shifts × labor cost	Time spent finding procedures or answers
Inventory	Change in shortages × expediting cost + change in excess × holding cost	Shortage and expedite records

Net annual value = validated drivers − (hardware + integration + model operation + labeling + support). Include false alarms as a cost: a maintenance model that triggers unnecessary inspections consumes the time it was meant to save.

✦ 05 / DELIVERY

A phased implementation plan

Prove value on one line, then standardize the platform so the second and third plants are faster than the first.

01 **Assess and baseline**

Choose one line and use case, map data sources across OT and IT, and measure the current cost of the problem.

02 **Secure the data path**

Set up the industrial DMZ, read-only connectors and time-series storage with the OT team.

03 **Pilot in shadow mode**

Run the model alongside current practice, compare its calls with inspectors or maintenance engineers, and tune.

04 **Go live with human confirmation**

Alerts and assistant answers feed existing workflows — CMMS, QMS, shift handover — with a person confirming each action.

05 **Scale and standardize**

Template the connectors, models and dashboards, then roll out to similar lines and plants.

We use the same building blocks here as in our own platforms: retrieval over controlled documents, agent workflows with human approval, and full audit trails — adapted to edge deployment and OT security for the shop floor.

✦ 06 / RISKS

Pitfalls to avoid

Manufacturing AI pilots often succeed in the lab and stall on the line. These are the usual reasons.

PITFALL	INSTEAD
Models trained only on good parts	Collect and label real defects; plan for rare classes
Cloud dependency for inline decisions	Edge inference with offline fallback
SOP assistant indexing every draft	Index only the controlled, current revision
IT projects that bypass the OT team	Joint IT/OT ownership from day one
Alerts nobody is responsible for	Every alert routed to a named role with a response time

Before go-live

- [ ] AI components placed in defined IEC 62443 zones
- [ ] No AI in safety functions; setpoint changes need human approval
- [ ] Shadow-mode results reviewed by quality or maintenance leads
- [ ] SOP assistant answers cite document number and revision
- [ ] Baseline recorded so ROI can be validated

GET IN TOUCH

Let's Talk

We build manufacturing AI that works on the line — inspection, maintenance, SOP assistants and planning — integrated securely with your OT and IT systems.

- A plant walkthrough and use-case shortlist
- OT/IT architecture and security review
- A shadow-mode pilot plan with a baseline
- A roadmap from one line to many plants

BOOK AN AI STRATEGY SESSION →

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