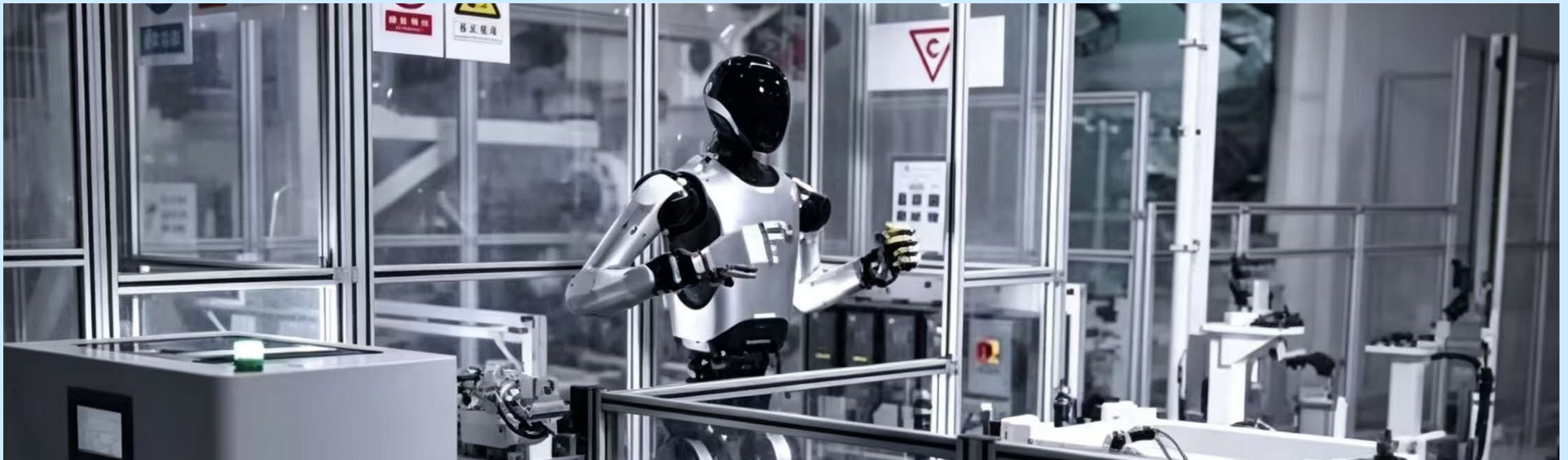


Germany's Productivity Imperative: Where AI and Advanced Tech Create Real Shopfloor Leverage

Germany does not have an automation problem.
It has an integration problem worth 15–25% of production cost.

35th Aachen Automotive Colloquium
6 October 2026



Germany lost output three years running with the world's third-highest robot density: the controllable gap is use, not hardware

-1.3%

Manufacturing gross value added in Germany 2025, the **third annual decline in a row**; automotive and machinery with the largest losses

2017

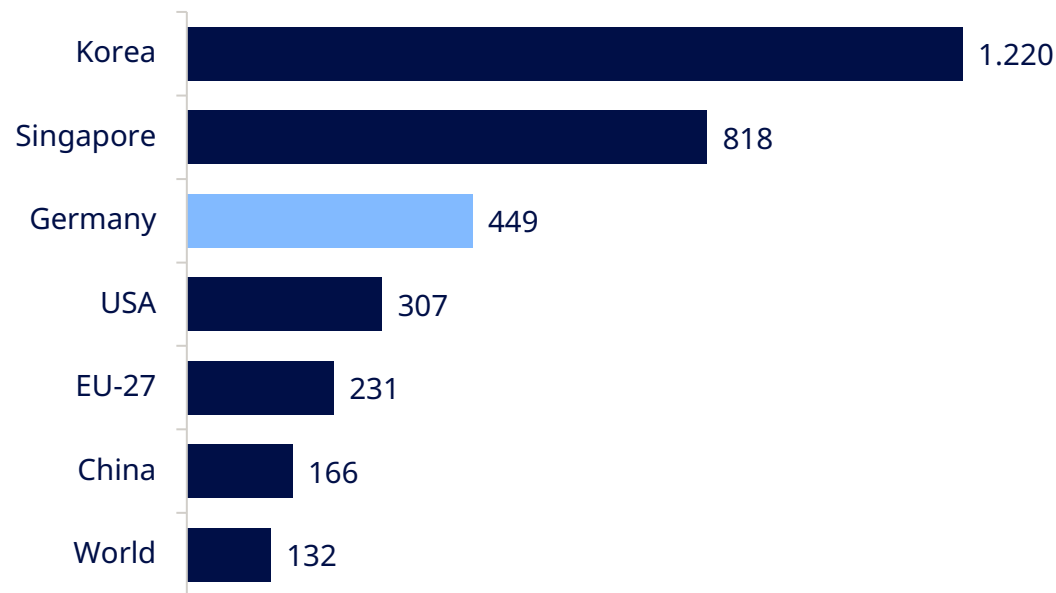
Peak year of industrial output per hour in Germany; the Bundesbank productivity index for industry has stayed below that level since

No. 3

Germany's rank in **robot density worldwide**: 449 robots per 10,000 employees, growing 5% a year since 2019

Robot density 2024

Industrial robots per 10,000 manufacturing employees



China ranks 22nd by density after a labour-statistics revision, but holds about **2 million installed robots** and took **54% of all new installations** in 2024

Volume fell, and that part belongs to the market. Germany is still one of the three most automated economies and loses output per hour: the controllable gap is utilisation and integration, not more hardware.

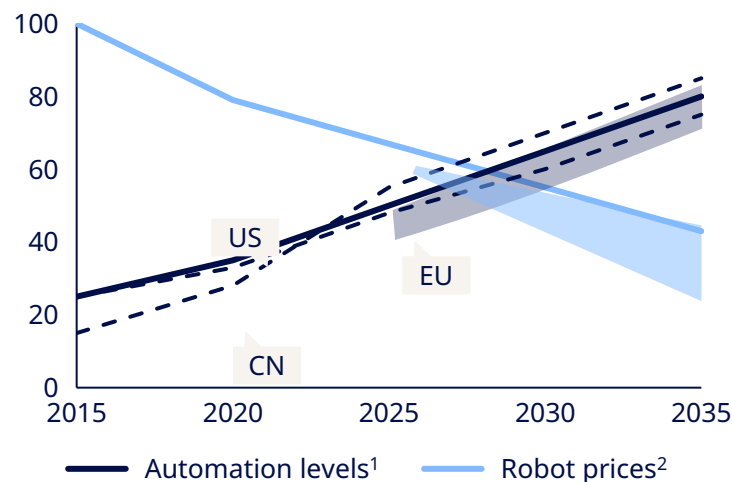
Sources: Destatis, GDP 2025 press release (15 Jan 2026); Deutsche Bundesbank, productivity index for industry (monthly, peak Nov 2017); IFR World Robotics 2025 (data 2024)

The window opened after Industrie 4.0: robots got cheap, labour got dearer, and models can read plant data and act on it

Robots and AMRs became affordable

Robotics affordability & automation levels

Indexed price development (2015 = 100)

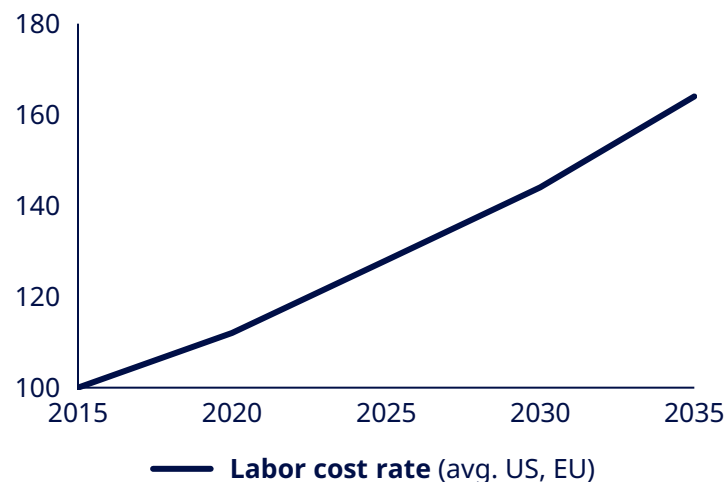


Robot prices are projected to **fall up to 55% by 2035** while automation levels rise; typical robotics payback has fallen from 6–7 years (2015) to 2–3 years (2025)

Labour cost keeps rising

Labour cost development

Indexed 2015, average US and EU



Labour cost is projected at **1.3x** the 2025 level **by 2035** (US/EU average); German manufacturing sits among the highest labour-cost locations in the EU

Models can read data, agents can act on it

What changed on the software side

Capabilities in series production, 2026

- Foundation models **read the data Industrie 4.0 never captured**: fault texts, shift books, maintenance logs, supplier documents
- Vision models **inspect inline at line speed**, on ordinary cameras, and learn new variants in days rather than months
- Planning agents propose sequence, capacity and maintenance decisions and **act inside the loop** that dashboards only displayed
- **Integration effort, not model capability**, is now the binding constraint

The 2013 stack could only use structured data and display it. The **2026** stack reads the **unstructured information** and **proposes the next action**

Proven payoff sits in the digital backbone and intralogistics robots; AI is promise, with inline inspection the one exception

Lever	Physical robots · 2 of 5 proven	Agentic AI · 1 of 5 proven	Digital backbone · 4 of 5 proven
Throughput / OEE	Plausible Cobots in assembly, machine tending	Plausible Scheduling, predictive maintenance	Proven Loss transparency in daily management · OEE +10–20%
Quality / scrap	Plausible Consistency in joining, dispensing	Proven Inline visual inspection · 90–95% detection	Proven Traceability, SPC, closed quality loops
Labour productivity	Proven Cobots, palletising, machine tending · +15–35%	Plausible GenAI assistants, guided work	Plausible Paperless, digital work instructions
Intralogistics	Proven AMRs, automated storage · ~1 year payback	Plausible Fleet optimisation, dynamic slotting	Proven WMS as the orchestration layer
Energy	Not a lever	Plausible Load, HVAC, compressed-air optimisation	Proven Submetering and energy management

 Proven in series production  Plausible: works in narrow scope, not proven at scale  Not a lever · Humanoid robots: in no cell yet

Invest now where the cell is proven: backbone, intralogistics robots, inline inspection. Pilot the plausible cells with a kill date (Gartner: over 40% of agentic AI projects cancelled by 2027). No money on humanoids yet.

Grading: proven = established technology, clear ROI, low integration risk, seen in series production; plausible = emerging or narrow scope, variable ROI. Ranges indicative: International Journal of Scientific Research in CSE and IT, Labour Economics, Oliver Wyman plant assessments 2025–2026. Agentic AI cancellations: Gartner, June 2025. Grading: Oliver Wyman assessment 2026

A Future Factory strategy for a European manufacturer takes 15–25% out of production cost by 2035, backbone first

The strategy

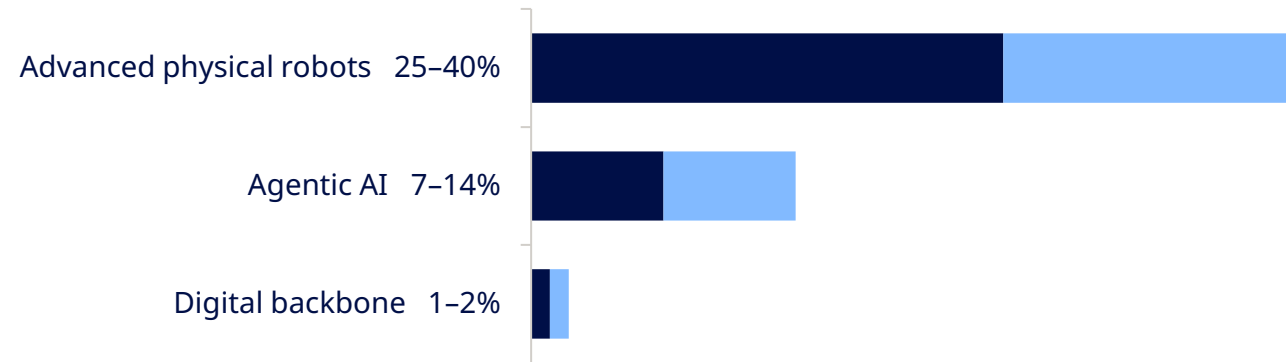
- Undisclosed client: **European premium consumer-appliance manufacturer**, high-cost Western European production; injection moulding, electronics and final assembly, packaging, own warehousing; two sites, 2025
- Future Factory strategy to 2035: **target picture, technology roadmap and business case** across advanced robots, agentic AI and digital backbone
- **13 process steps** from component manufacturing to order picking; business case **validated with plant cost and FTE data**, confidence graded per technology

The result

- **15–25% of production cost** (excl. material) addressable by 2035, net of OpEx and annualised CapEx; **15–35% in warehousing**
- Backbone investment about **one sixth of the robotics investment**, and listed as its precondition
- Roadmap starts with the **foundation, not with the robots**

Saving potential on key production processes by 2035

Percent of addressable cost, gross, by technology domain (bar = range)



- **Requirements attached to the robotics lever** in the strategy: real-time sensor fusion, integrated ERP, IoT and process controls, skilled operators for cell management, scalable IT
- **Without the 1–2% lever, the 25–40% does not materialise:** no usable data, no intelligent robots
- **Transfer to automotive:** the process steps are the same as in a Tier-1 plant, the OEM-dictated takt and PPAP change control are not; the payback ranges transfer, the implementation speed does not

15–25% by 2035 is 2–3% a year: roughly the annual productivity clause most Tier-1s have already signed. The technology exists today; the 1–2% lever funded first decides whether a plant gets there.

Business case modelled with plant data within the client's Future Factory strategy, Oliver Wyman 2025. Not a measured operating result. Domain figures gross, on key production processes; site total net of OpEx and CapEx annualised over seven years

The strategy assigns a technology, a target automation level and a modelled effect to each of the 13 process steps

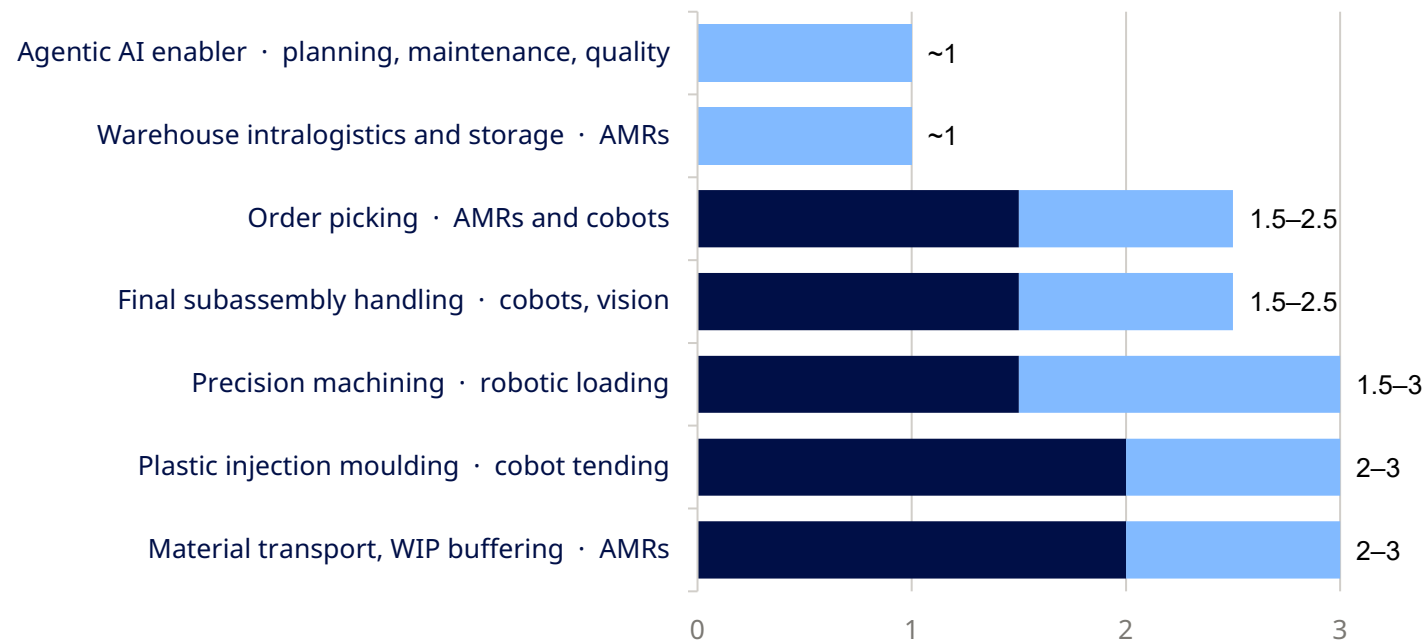
Productivity +15–35% labour productivity, modelled		Quality 90–95% defect detection accuracy		Cost 15–25% of production cost net, 35–55% gross on key processes		Payback 1–3 years by process step	
Injection molding – Tech Milestone 2027 AI quality and adaptive processing		Precision machining – Tech Milestone 2028 Robotic loading + AI optimisation		Final assembly – Tech Milestone 2026 Cobot collaboration + vision			
Cycle time: -30% Automation level 35 → 92%		Cycle time: -60% Automation level 45 → 95%		Cycle time: -85% Automation level 25 → 75%			
Today Manual setup, periodic checks, reactive adjustments Tech: Fixed CNC, manual inspection, basic sensors		Today Operator-supervised, manual tool changes, scheduled maintenance Tech: Standard CNC, basic CAM, manual measurement		Today Manual assembly, paper instructions, human QC, fixed layouts Tech: Manual tools, basic fixtures, printed docs		Target until 2035 Flexible cobot-assist, AR instructions, AI vision inspection, modular cells Tech: Collaborative robots, AR glasses, 3D vision, AI defect detection, modular cells	
Assembly advanced – Tech Milestone 2030 Gen AI sequence optimization		Intralogistics – Tech Milestone 2027 Autonomous fleet + smart flow		Smart factory – Tech Milestone 2032 AI-Powered orchestration			
Cycle time: -70% Automation level 30 → 85%		Cycle time: -45% Automation level 40 → 90%		Cycle time: -35% Automation level 35 → 88%			
Today Static sequences, manual ergonomics, linear flow Tech: Fixed workstations, manual time studies		Today Fixed conveyors, manual forklifts, paper routing, static zones Tech: Conveyors, manual forklifts, barcodes, basic WMS		Today Siloed systems, manual planning, reactive scheduling Tech: Standalone MES, basic ERP, manual reports		Target until 2035 Unified AI orchestration, autonomous scheduling, predictive supply chain Tech: AI/ML control, unified data platform, 5G, edge+cloud, end-to-end traceability	

Target state modelled with plant data within the client’s Future Factory strategy, Oliver Wyman 2025. Not a measured operating result. Per-step effects are target-state assumptions; site-level net effect 15–25% of production cost. Sources: plant data, expert interviews, IFR World Robotics, IEEE Automation Science and Engineering, CIRP, Oliver Wyman analysis

Payback of one to three years per process step sets the roadmap: one-year cases first, their savings fund the backbone

Payback by process step

Years, modelled with plant data; bar = range, blue = one-year cases



Effects lag one to two years behind the investment: an investment today is not this year's FTE saving.

Roadmap derived from the payback

Year 1	Foundation, self-funding • Backbone: MES/WMS, machine data, one loss definition; in-house automation and data roles • One-year cases: AMRs, cobot machine tending, AI enabler
Years 2–3	Scale the proven cells • Cobots in assembly, inline inspection, scheduling once planning data is usable • Every use case with a routine and an owner
Year 3+	Extend into plausible cells • Predictive maintenance, closed-loop quality, GenAI on the floor • Humanoids: watch, don't buy

Start with the one-year cases: they clear a 24-month hurdle without negotiated FTE savings. Their first savings fund the backbone, and the backbone unlocks the 25–40%.

Business case modelled with plant data within the client's Future Factory strategy, Oliver Wyman 2025. Not a measured operating result. Payback on CapEx incl. implementation, annualised over seven years; OpEx for technology, maintenance and automation experts included; FTE savings blue collar plus 0.2 white collar per blue collar. Second-order effects per step in speaker notes

Most plants have not captured the window: pilots died for three reasons, and the winners fixed exactly those three

73% of mid-sized manufacturers are still in the AI testing phase and none has AI fully operational across the business; 93% own an MES, 23% have integrated it

The evidence	Why the pilot died	What the winners had in place
23% of MES owners have fully integrated the system; 93% own one	No data foundation Machine-level data sat in controllers nobody could read, or on paper. A year of plumbing before the first prediction.	Usable data Integrated ERP, MES and process controls; machine data exported; one definition of a loss across the plant.
83% of companies run shopfloor management, most of them not across all hierarchy levels	No routine that used the output Alerts were displayed. Nobody had to act by a set time in a set meeting, so nobody did.	Stable process and standard work The standard says who decides and by when; the agent proposes. AI on an unstable process automates the noise.
42% of enterprises abandoned most of their AI initiatives in 2025, up from 17% the year before	No owner on the floor The pilot belonged to the digital team or the vendor. When the champion left, the dashboard went dark.	An owner on the floor One KPI owner per line, in-house automation skills, works council in the room early.

The technology usually worked. The plant around it did not change. Fix the plant first: integrate the systems you already own, wire the output into a routine, name the owner.

Sources: Kaufman Rossin, mid-market manufacturing AI survey 2026 (73%, none operational); Rockwell Automation, State of Smart Manufacturing, 1,560 decision-makers (93%, 23%); WGP, Wissenschaftliche Gesellschaft für Produktionstechnik, citing a 2018 shopfloor-management study (82.5%); S&P Global Market Intelligence, AI survey 2025 (42%, 17%); Oliver Wyman project experience

AI pays where the management system absorbs it: each use case lands in a routine, a decision and an owner, or it does not land

83% of companies run shopfloor management, most not across all hierarchy levels; **the routine that reaches every level, not the model, is the scarce asset**

	Routine	AI use case plugged in	Decision taken there	Effect when absorbed
Plant	Weekly performance review , monthly capex round	Planning agent : capacity and schedule scenarios; energy load on submetered data	Release capex , rank losses across lines	~1 yr AI enabler payback in the strategy, if the backbone is funded first
Line / area	Daily line review at the board, 15 minutes, same time every day	Loss analytics : ranked downtime causes from machine data and shift logs; maintenance alerts	Root-cause action with an owner and a due date today	+10–20% OEE from loss transparency worked in a daily routine; zero without it
Shift / cell	Shift start and end-of-shift handover	Inline inspection alert with recommended action; AMR and cobot status; GenAI handover summary	Adjust sequence, react to deviation, escalate	90–95% inline detection accuracy; alert-to-action inside the shift, not at the next audit

Three tests per use case before any rollout: which routine, which decision, which owner. Use cases that fail one test are pilots with a kill date, not investments.

Sources: WGP, Wissenschaftliche Gesellschaft für Produktionstechnik, citing a 2018 shopfloor-management study (82.5%, hierarchy levels); OEE range: literature and Oliver Wyman plant assessments; AI enabler payback and detection accuracy: Oliver Wyman Future Factory strategy 2025, modelled with plant data; Oliver Wyman next-generation Lean management system

Manufacturing strategy for the future: five decisions that keep Germany and the EU a competitive manufacturing location

- 1 Footprint:** which products and process steps still earn their place in Germany in 2035, and which move to CEE, Mexico or China?
Our position: 72% of German suppliers postpone, relocate or cancel investment here. Decide the footprint yourself in 2027: a 2030 automation target per process step; what misses it is exited by plan, and the capital goes to the steps that stay.
- 2 Automation ambition:** dark factory, or a human-centred plant with a different skill mix by 2035?
Our position: Lights-out runs in single-product electronics; humanoids reach ~90% task success where a line needs 99%+. Target the unmanned third shift, not the dark factory: every new machining and moulding line lights-out at night by 2030.
- 3 Capital allocation:** modernise the German brownfield or build greenfield in a low-cost region, and at what hurdle?
Our position: Stop approving robots and AI use case by use case. Approve one portfolio per site: backbone plus one-year cases, 24-month hurdle on the portfolio. The cases pay for the backbone, which alone saves only 1–2% and fails every single-case test.
- 4 Capability:** build or buy the automation, data and AI competence, in a market where skilled engineers are the scarcer input?
Our position: Hire the automation, data and cell-management team before the robots; without it a plant runs the vendor's roadmap. Write the roadmap into the Betriebsvereinbarung: co-owned targets and redeployment to 2030 in exchange for standard-work changes.
- 5 Cost of waiting:** with 2–3% annual price-downs and rising labour cost, when does a German plant lose the next allocation?
Our position: Two thirds of German suppliers cut domestic jobs in 2025, and the next allocation is decided within 24 months. Set the test now: backbone funded, two one-year cases live, productivity at or above the price-down. Pass keeps the product; fail triggers the footprint decision.

Germany is the third most automated economy in the world and still loses output per hour. Without the productivity, German plants lose the next allocation round to sites with a fraction of the labour cost. The technology exists today; what decides the location is a manufacturing strategy that funds the foundation first and lets the technology pay.

Sources: VDA supplier survey, annual press conference Feb 2026 (72%, 28%, two thirds, 49%); Xiaomi Changping and humanoid trial: company statements and press reports 2024–2026; backbone economics and OpEx logic: Oliver Wyman Future Factory strategy 2025; Destatis, GDP 2025; IFR World Robotics 2025. Price-down range: typical Tier-1 productivity clauses. Positions, thresholds and deadlines: Oliver Wyman view

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