THE FUTURE COLLECTIVE | ORACLE NetSuite

# Manufacturing Futures

## Tomorrow's Vision

# Foreword

Manufacturing underpins the global economy, connecting supply chains, enabling product innovation and producing the goods that industries rely on. Today, it is operating under increasing pressure, as complexity rises, volatility persists and expectations of performance continue to grow.

At Oracle NetSuite, we work closely with manufacturers navigating these challenges every day. That perspective provides a clear view of how the industry is changing. Intelligence is embedded into operations, supply networks are adapting to disruption and product lifecycles are being redefined.

This report, produced in partnership with The Future Collective, brings together the key trends shaping manufacturing's next phase. It explores the structural shifts shaping manufacturing, from more connected production systems to more resilient supply chains and new models of value creation.

Our aim is to help manufacturing leaders understand what is emerging and where to focus next. The organisations that succeed will be those that can translate insight into action, align systems and processes and operate with greater clarity across increasingly complex environments.

As the leading AI cloud ERP, spanning financials, operations, CRM and commerce, Oracle NetSuite is committed to supporting manufacturers as they navigate this next phase of change.

The challenge is clear. So is the opportunity.

**Kath Brameld**
Manufacturing Industry Director, Oracle NetSuite

**See why NetSuite is the number one AI Cloud ERP**

# Overview

# Introduction

Manufacturing is being reshaped by a new set of challenges and possibilities. Systems built for stability are being tested by rising complexity, faster cycles of change and increasing demands on performance.

The operating environment is becoming harder to predict. Disruption is constant, capacity is constrained and expectations of speed, efficiency and reliability are rising. This is placing greater strain on how manufacturing systems are designed and run.

This report explores the trends shaping manufacturing's next phase and the capabilities required to operate, compete and grow in a more dynamic, connected and performance-driven landscape.

# The Forces Reshaping Manufacturing

The manufacturing landscape is being defined by structural tensions – from global volatility and supply chain disruption to the accelerating adoption of intelligent systems, alongside a shrinking workforce and rising sustainability demands.

# Disruption As Default

**Unpredictability is the new operating reality.**

Disruption is becoming a constant condition across manufacturing supply chains, markets and operations. Economic volatility and geopolitical instability are now among the most significant risks facing the sector, cited by 52% and 50% of manufacturers respectively (Make UK, 2026). Global supply chains are also under sustained pressure, with 83% of supply chain leaders expecting ongoing disruption to have a permanent negative impact on margins (DP World, 2025).

The scale and frequency of disruption are exposing the limits of traditional operating models. Across MENA, 72% of firms affected by disruption report operational downtime exceeding one month, among the highest rates globally (DP World, 2025).

These effects extend beyond operations, with 78% of European businesses experiencing increased customer complaints and 55% losing business as a direct result of disruption (DP World, 2025).

As disruption becomes systemic, manufacturers are being forced to rethink how they design and manage production networks. Global trade routes, supplier ecosystems and production footprints are being reassessed in response to shifting geopolitical and economic conditions. Competitive advantage is increasingly defined by the ability to anticipate risk, adapt quickly and build resilience directly into operations, rather than responding after disruption occurs.

> “Volatility is no longer a temporary disruption; it is a structural condition leaders must plan for.”
>
> Kiva Allgood, Managing Director, World Economic Forum (2025).

# Accelerating Intelligence

**Intelligence scales across the system.**

Intelligence is being embedded across manufacturing operations, as data connects machines, processes and supply networks in real time. AI is already being used to optimise maintenance, quality, energy and planning, enabling faster decisions and more adaptive performance. Adoption is well underway, with 74% of manufacturers using machine learning and 72% deploying predictive analytics (KPMG, 2025), while 53% identify AI as critical to achieving their strategic goals (PwC, 2025).

As adoption scales, intelligence is starting to shape how production systems operate day to day. The industry is also seeing a growing level of AI maturity, with 62% of manufacturers having used AI for over three years and 84% actively developing solutions in-house (KPMG, 2025).

Open-source tools are accelerating this shift, with 70% making significant use of them (KPMG, 2025). Yet many organisations still deploy these technologies in silos, limiting their impact.

Exposure is also increasing as intelligence becomes more embedded and interconnected. Greater connectivity is widening the attack surface, with 78% of UK manufacturers experiencing cyber incidents in the past year (ESET, 2025). Competitive advantage is emerging for those that can connect intelligence across functions, align decisions in real time and build operations that continuously learn and adapt.

> "The biggest gains for AI in manufacturing will come from connecting systems end-to-end."
>
> Laura Capper, Head of Manufacturing, Natwest (2026)

# Shrinking Workforce

**Fewer workers, greater capability demands.**

Manufacturing is facing a shrinking workforce as skill requirements become more complex. In the UK alone, nearly 600,000 manufacturing workers are expected to reach retirement age by 2035, accelerating a demographic shift that is already underway (Make UK, 2025). Across the sector, 24% of employees are aged 55 or older, while rising demand for advanced technical and digital skills is outpacing the available talent pool (Deloitte, 2025).

This is creating a structural imbalance. As experienced workers exit, critical operational knowledge is leaving with them faster than it can be transferred or replaced. 87% of UK manufacturing managers report that most technical expertise sits with older employees, while 81% say their teams already lack essential skills. At the same time, 94% believe younger workers are not yet equipped to fill these roles, increasing pressure on a shrinking core of experienced staff (Flip x Workplace Intelligence, 2025).

The result is a growing dependency on fewer individuals to sustain performance. More than 60% of manufacturers now cite talent recruitment and retention as their biggest challenge, while 80% report gaps in the skills required for Industry 4.0 environments (Deloitte, 2025). This is forcing a rethink of workforce strategy, with greater focus on continuous learning, faster onboarding and the use of AI and automation to extend human capability and preserve institutional knowledge.

> "UK manufacturing is standing on the edge of a skills cliff. The future depends on a new generation of skilled workers."
>
> Benedikt Brand, Co-Founder & CEO, Flip (2025).

# Sustainability Imperative

> "Europe's geopolitical reality has further elevated sustainability as a strategic business imperative."
>
> Fair Trade Advocacy Office, March 2026.

Image Source: Future Stores, London

**Sustainability shifts from ambition to requirement.**

Sustainability is a core requirement across manufacturing, as environmental impact, energy use and resource intensity come under increasing scrutiny. The sector accounts for around one-fifth of global carbon emissions, placing it at the centre of decarbonisation efforts (MHA, 2025).

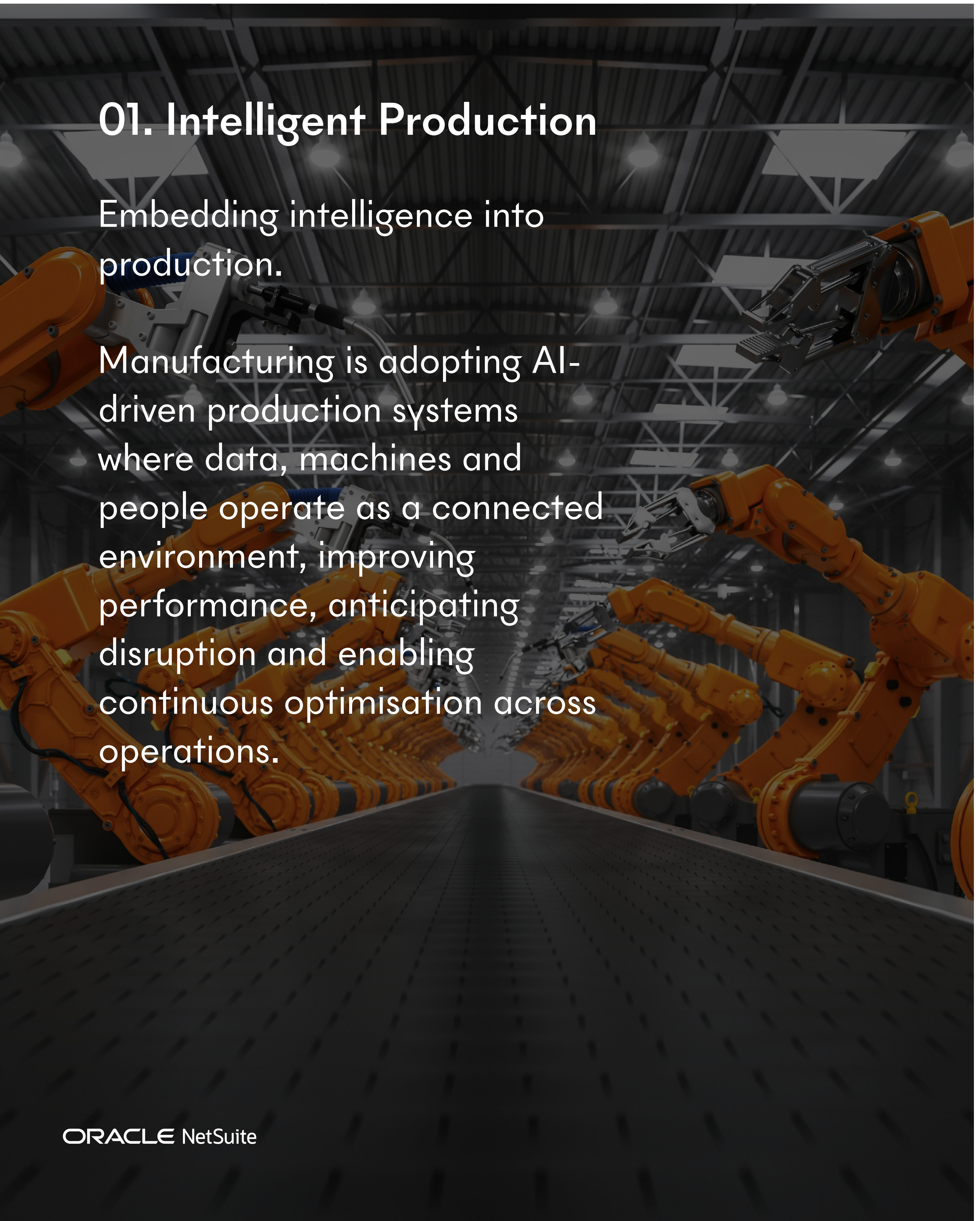
Pressure is also intensifying from regulators, customers and investors, with 47% of manufacturers reporting growing demands to provide sustainability data and demonstrate progress (9altitudes, 2025). This shift is moving sustainability into the centre of business strategy. It is now a frequent trigger for board-level decision-making, influencing operational performance, cost management and market access (FRP, 2025).

In response, 8 in 10 manufacturers are planning to embed green growth into their operations over the next five years, with nearly half prioritising renewable energy investment (Make UK, 2025). Sustainability is becoming a key driver of resilience, efficiency and competitiveness.

However, readiness remains uneven. Only 50% of manufacturers currently have a formal sustainability framework in place, while 75% lack the data infrastructure needed to manage sustainability effectively (MHA, 2025). As regulation tightens and expectations rise, the ability to measure, manage and reduce impact is essential. Manufacturers that embed sustainability into core operations will be better positioned to secure energy stability, meet compliance requirements and compete in a more resource-constrained industrial landscape.

# Manufacturing Futures Equation

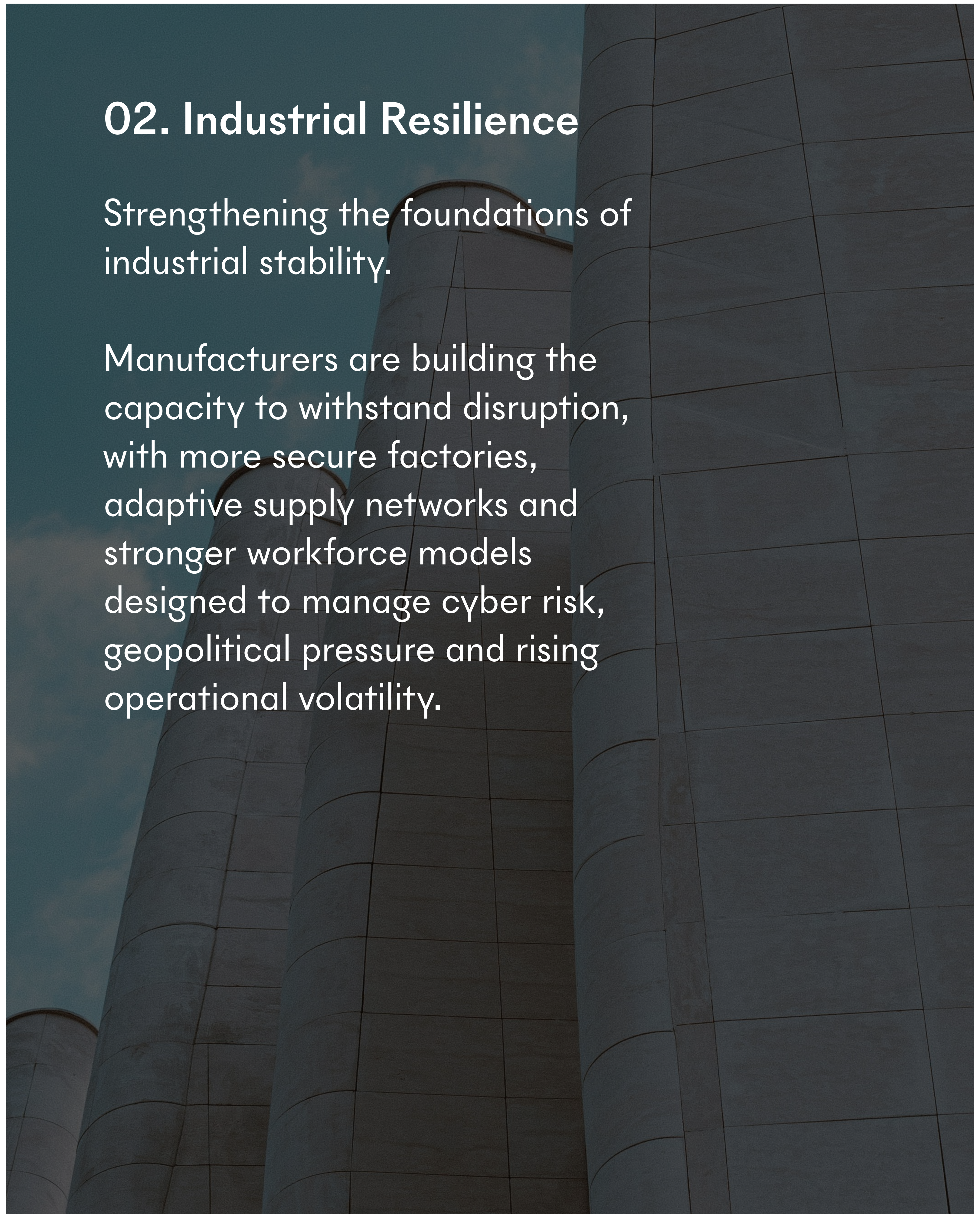
**Three interconnected pillars are powering the future of manufacturing.**



## 01. Intelligent Production

Embedding intelligence into production.

Manufacturing is adopting AI-driven production systems where data, machines and people operate as a connected environment, improving performance, anticipating disruption and enabling continuous optimisation across operations.



## 02. Industrial Resilience

Strengthening the foundations of industrial stability.

Manufacturers are building the capacity to withstand disruption, with more secure factories, adaptive supply networks and stronger workforce models designed to manage cyber risk, geopolitical pressure and rising operational volatility.

## 03. Engineered Value

Redesigning how value is created, captured and extended.

Across manufacturing, value is being reshaped through how products are produced, powered and sustained, with new models built on energy autonomy, advanced materials, traceability and lifecycle performance to maximise use, extend longevity and reduce waste by design.

# 01 Intelligent Production

- Cognitive Factories
- Ambient Agents
- Failure Foresight
- Shiftless Operations
- Parallel Systems

# Cognitive Factories

## What happens when factories start to sense, learn and act?

Factories are starting to operate as systems that can sense conditions, learn from data and act on insight. As sensors, IoT and AI converge, intelligence is moving directly into production, enabling operations to anticipate disruption, adapt to change and improve performance in real-time.

> "The global sensor market will reach $250 billion by 2036, with sensors for robotics, automation and IoT poised as key growth markets."
>
> IDTechEx (2026) Sensor Market 2026-2036.

### The Future Forecast

Production environments now generate a live, unified view across machines, materials and workflows. This level of visibility allows manufacturers to understand performance as it unfolds, revealing issues earlier and improving how decisions are made across operations.

Connected systems bring together signals from across the factory, creating a continuous picture of machine health, material flow, quality and energy use. This enables teams to identify patterns, diagnose root causes and respond with greater precision, improving coordination across workflows and reducing reliance on fragmented reporting.

As these capabilities mature, visibility becomes a foundation for more advanced execution. Closed-loop manufacturing links sensing, analysis and response, allowing systems to act on emerging conditions in real-time. Edge AI – where data is processed directly on the factory floor – brings decision-making closer to operations, enabling faster, more accurate responses without reliance on human input or cloud latency.

With automation and AI in manufacturing expected to more than double by 2030 (PwC, 2026), and Industrial IoT projected to reach $673 billion by 2032 (Fortune Business Insights, 2026), advantage will depend on how effectively this intelligence is translated into coordinated action.

### Pioneers in Action

- Canadian technology company ZeroKey has launched OmniVisor AI, a platform that combines ultra-precise location tracking with AI to create a detailed, real-time view of factory operations. Using millimetre-level spatial data, it maps material flow, process performance and asset movement, helping manufacturers identify inefficiencies and understand how production behaves in practice.

- Nokia's MX Context platform uses sensor fusion to combine data from machines, sensors and worker devices into a single, unified view of operations. By bringing together previously fragmented inputs, it enables manufacturers to interpret complex environments more clearly, improving situational awareness across safety, workflows and performance.

- Bosch's Blaichach factory uses its Nexeed software suite to connect data from more than 60,000 sensors across production. By analysing machine conditions in real-time, the system provides continuous visibility into asset performance, helping teams understand emerging issues earlier and make more informed decisions across operations.

### Strategic So What?

Operational visibility is becoming a defining driver of manufacturing performance, shaping how effectively organisations understand and manage production in real-time.

To succeed:

- Embed real-time sensing across production to create continuous visibility into machines, materials and workflows.
- Unify data across systems to build a single, coherent view of operations rather than fragmented insights.
- Enable decision-making based on shared, live understanding, improving alignment across teams and processes.

When manufacturers can clearly understand what is happening across operations, decisions become more precise, coordination improves and performance becomes easier to manage at scale.

# Ambient Agents

## Who is really in control when decisions run themselves?

Industrial AI agents are creating a new execution layer in manufacturing. Decisions are made and carried out directly within workflows, allowing processes across planning, production and operations to run with greater speed and coordination. As these systems scale, execution becomes more fluid, with fewer delays between insight and action.

> "We envision a future where industrial AI agents work seamlessly alongside human workers, handling routine processes independently while enabling humans to focus on innovation, creativity and complex problem-solving."

Rainer Brehm, CEO Factory Automation, Siemens Digital Industries (2025).

### The Future Forecast

Decisions are increasingly made and executed within workflows. Production, planning and operations run with greater speed, alignment and consistency as coordination happens directly within systems rather than across layers.

As AI agents take on routine judgement, execution shifts closer to where work happens. This reduces reliance on approvals, handoffs and manual intervention, enabling faster responses and more predictable outcomes across operations. While only 6% of manufacturers currently use agentic AI, adoption is expected to rise to 24% within two years and quadruple by 2027 (Deloitte, 2025).

Agents are also beginning to connect decisions across systems, linking processes that were previously managed in isolation. By 2027, 40% of operational data will be integrated autonomously across applications through AI agents (IDC, 2026), enabling more coordinated execution across the enterprise.

At scale, this creates a more fluid operating model, where decisions are resolved in real time and workflows adapt continuously. With agentic AI projected to generate $450 billion to $650 billion in annual value by 2030, alongside cost reductions of 30% to 50% (McKinsey, 2025), the focus shifts to how decision-making is embedded, coordinated and controlled across systems.

### Pioneers in Action

- Siemens is embedding AI agents across its industrial copilot stack, spanning design, planning, engineering and operations. These agents generate automation code, optimise production schedules and guide shop floor decisions through natural language interfaces, connecting workflows end-to-end and automating execution across the value chain.
- Swedish-Swiss technology leader ABB's Genix platform combines real-time sensor data, process analytics and knowledge graphs with agentic AI to optimise industrial operations. It detects anomalies, predicts failures and recommends actions across assets and systems, enabling faster, more coordinated decision-making across reliability, efficiency and sustainability.
- Bosch is deploying multi-agent AI systems that monitor equipment, predict maintenance needs and dynamically adjust production and workforce schedules. These agents operate in parallel, continuously coordinating decisions across the factory. The result is reduced unplanned downtime and measurable gains in productivity and operational stability.

### Strategic So What?

Decision-making is becoming embedded within workflows, changing how execution is coordinated across manufacturing operations.

Manufacturers should:

- Redesign workflows so routine decisions are executed within systems rather than passed between teams.
- Integrate data and processes across planning, production and supply chains to enable continuous, coordinated action.
- Define clear human roles focused on oversight, exceptions and accountability as system autonomy increases.

Embedding decisions within the flow of operations enables faster execution, stronger consistency and greater scalability across complex environments.

# Failure Foresight

## Can machines fix faults before anything breaks?

Maintenance is becoming a system of intervention, where issues are identified and addressed before they affect performance. Manufacturers are building capabilities that reduce disruption by acting early, stabilising operations and protecting output. Reliability will depend on how effectively systems prevent failure from occurring.

"As intelligence becomes embedded, maintenance moves from prediction to intervention – ensuring issues are addressed before they can disrupt performance."

Kath Brameld, Manufacturing Industry Director, Oracle NetSuite (2026).

### The Future Forecast

Risk is being addressed before it disrupts performance. Maintenance systems are identifying issues earlier and triggering targeted responses, reducing unplanned downtime and stabilising operations as complexity increases.

The cost of failure remains significant. UK and European manufacturers lost more than £80 billion to downtime in 2025 (IDS-INDATA, 2025), while 61% of global manufacturers experienced unplanned downtime, with costs reaching up to $852 million per week (Fluke, 2025). In response, maintenance is becoming more integrated into core operations, with 18% of leaders already using predictive approaches and a further 35% preparing to scale them (Fluke, 2025).

The focus is shifting beyond prediction to intervention. Prescriptive systems determine the required response and initiate action automatically, drawing on asset condition, performance history and operating context. This enables earlier, more precise interventions that prevent issues from escalating. Predictive tools have already reduced downtime by up to 50% (IDS-INDATA, 2025), while AI-driven approaches can cut downtime by 35–45% and maintenance costs by 25–30% (IBM, 2025). As these capabilities scale, maintenance becomes a continuous control mechanism, ensuring performance remains stable even as systems grow more complex.

### Pioneers in Action

- AI platform Aquant analyses historical service data alongside live sensor inputs to diagnose issues and recommend precise maintenance actions. By filtering false positives and prescribing specific interventions – including when to shut down equipment – it enables manufacturers like Coca-Cola and HP to prevent failures while reducing unnecessary repairs and cutting service costs by up to 23%.
- Industrial AI platform Infinite Uptime is deploying prescriptive AI agents that go beyond anomaly detection to recommend specific mechanical fixes in real-time. These systems translate sensor data into actionable interventions, reportedly saving over 125,000 hours of downtime by ensuring issues are not just identified, but resolved before they escalate into failure.
- Siemens is using edge AI and embedded sensors to move from prediction into real-time intervention. When anomalies are detected, systems automatically adjust machine parameters – slowing motors, balancing loads or triggering cooling – preventing failures before they occur. This shifts maintenance from alerting teams to actively stabilising operations as issues emerge.

### Strategic So What?

Maintenance is becoming a system of control, where performance is stabilised through early, targeted intervention.

To stay ahead:
- Embed real-time sensing across critical assets to identify risk as it emerges.
- Connect maintenance, operations and performance data to enable accurate diagnosis and timely intervention.
- Integrate prescriptive responses directly into operations, ensuring issues are addressed without delay.

Early and consistent intervention reduces disruption, stabilises performance and turns reliability into a managed outcome rather than an operational risk.

# Shiftless Operations

## When do factories need people?

As cobots become more adaptive, factories are no longer constrained by fixed labour windows or standardised tasks. The same systems can work safely with people during the day and continue independently without them, creating a more flexible model for deploying labour, capacity and energy.

> "Cobots can now make intelligent decisions, recognize objects dynamically, plan movements adaptively, predict behaviors, and collaborate with humans in real time."

Jasmeet Singh, Executive Vice-President & Global Head of Manufacturing, Infosys (2025).

### The Future Forecast

The factory day is becoming less tied to the human shift. Advances in vision systems, motion control and real-time adaptability are allowing production to extend beyond staffed hours, moving from simple, repetitive environments into variable, high-mix settings that previously depended on constant human presence. Automation is advancing into more complex, variable environments, adapting to changing inputs and operating with minimal intervention.

Advanced automation is already delivering measurable impact, with productivity gains of 20% to 30% reported across industrial environments (Bosch SDS, 2024). Across Europe, more than 80% of cobot users are seeing double-digit improvements, many exceeding 25% (Universal Robots, 2025), indicating that performance gains are becoming consistent as adoption matures. With the market set to grow by over 20% annually and double by 2030 (ABB, 2025), continuous, shiftless operation is becoming the operating norm rather than an edge case.

As this model scales, factories progress towards lights-out manufacturing, where autonomous cells extend output beyond staffed hours while people focus on oversight, changeovers and exception handling. Labour is deployed more selectively, and machines operate with greater continuity and precision. Energy and assets are used more efficiently, with fewer idle periods and more consistent utilisation. As a result, production is shaped by demand and capacity rather than the limits of human shifts.

### Pioneers in Action

- Electronics manufacturer Xiaomi's Changping Smart Factory in Beijing represents one of the most advanced examples of near-humanless manufacturing. The 81,000m² facility runs 24/7 using robotics, machine vision, automated logistics and its proprietary HyperIMP AI platform to optimise production, quality control and maintenance in real time. While not entirely human-free, it shows how AI-managed systems can sustain continuous, high-volume production with minimal on-site interventions.
- HVAC manufacturer Gree's Gaolan Smart Manufacturing Facility in Zhuhai is the world's largest 5.5G-native lights-out factory, producing over 12 million air conditioners annually. By integrating IoT, digital twins and real-time data across production and logistics, it has increased efficiency by 86% compared to traditional factories. With only a small number of workers overseeing maintenance and quality, large-scale manufacturing operates with minimal human presence.
- Metal fabrication firm Raymath uses Universal Robots cobots to automate MIG welding and CNC machine tending in a high-mix, low-volume environment where traditional automation struggled. The result is fewer welding hours, faster throughput and 24-hour machining operations. It demonstrates how continuous production becomes viable even in variable, changeover-heavy manufacturing settings.

### Strategic So What?

Production models that extend beyond human working hours will redefine how capacity, cost and performance are optimised.

Manufacturers should:

- Design operations that can run autonomously beyond staffed hours, with clear handovers between human and machine-led execution.
- Invest in flexible automation that can handle variation, enabling continuous output across high-mix environments.
- Redefine workforce roles around oversight, intervention and optimisation rather than constant task execution.

Removing the limits of shift-based production enables continuous capacity, more targeted use of labour and greater uptime as a source of competitive advantage.

# Parallel Systems

## Which factory leads – the physical or the digital twin?

Manufacturing is developing a parallel operating layer in the virtual world. Built on live data, simulation and spatial computing, it allows teams to test changes, validate decisions and optimise performance before acting in the physical environment. The result is a more informed and responsive approach to managing operations.

> "Manufacturing operates across virtual and physical environments, with performance defined in the digital layer before it is realised in the physical world."

Kath Brameld, Manufacturing Industry Director, Oracle NetSuite (2026).

### The Future Forecast

The next phase of manufacturing will be defined by the ability to operate across both physical and virtual environments simultaneously. As digital twins become more accurate, continuously updated and AI-enabled, they take on a more active role in operations. Digital twins enable manufacturers to simulate changes, identify risks and refine decisions before action is taken on the factory floor, improving outcomes while reducing uncertainty.

Digital twins are moving into operational use at scale, supported by increasing investment across industrial sectors. The global market is projected to reach $149.81 billion by 2030, growing at a CAGR of 47.9% (MarketsandMarkets, 2025). Already, 44% of companies are implementing digital twins for factory optimisation (McKinsey, 2025), indicating a shift from experimentation to embedded use. Extended Reality (XR) is advancing alongside this, with around 30% of manufacturers deploying XR tools and a further 32% integrating them into operations (ABI Research, 2024), enabling more immersive interaction with virtual environments.

This is giving rise to a new operating model. Virtual environments function as live workspaces, where engineers, operators and AI systems test layouts, validate interventions, support training and optimise performance in parallel with execution.

### Pioneers in Action

- PepsiCo is using Siemens' Digital Twin Composer and Nvidia Omniverse to create physics-accurate 3D replicas of US plants and warehouses. These live virtual models let teams simulate, validate and refine changes before physical implementation, identifying up to 90% of potential issues, increasing throughput by 20% and reducing capex by 10–15%.

- German packaging manufacturer Krones has built AI-driven digital twins for high-speed bottling operations. In one use case, fluid simulations used to prevent spillage were reduced from five hours to seven minutes, enabling real-time prediction, faster parameter tuning and a more active virtual layer for operational decision-making.

- Integrated with Apple Vision Pro, Nvidia CloudXR is bringing immersive digital twin environments into spatial computing. Taiwanese electronics manufacturer Foxconn is among the enterprises using this ecosystem to visualise complex and high quality 3D assets and simulations, showing how XR can turn digital twins into interactive workspaces for real-time industrial collaboration.

### Strategic So What?

Operating effectively across physical and virtual environments will define how manufacturers plan, test and execute with greater precision and control.

Success requires:

- Establishing digital twins as decision environments, where changes are tested and validated before execution.
- Integrating real-time data across assets, systems and workflows to ensure the virtual layer reflects live operations accurately.
- Embedding simulation and XR into everyday workflows, enabling teams to collaborate, train and optimise performance continuously.

Decisions made and refined before reaching the factory floor make operations more predictable, efficient and scalable.

# 02 Industrial Resilience

- Simulated Security
- Made Closer
- Self-Healing Chains
- Re-Engineering Talent
- Humanoid Workforce

# Simulated Security

## Are cyberattacks inevitable – but predictable?

Cyber disruption is becoming an ongoing reality for modern manufacturing. As factories, suppliers and industrial systems become more connected, reacting after disruption begins isn't enough. Manufacturers are developing the ability to test threats in advance, using simulated environments to expose weaknesses, validate defences and prepare responses before live systems are affected.

> "Manufacturing attacks are increasingly opportunistic, automated and IT-originated, then move laterally into OT."
>
> Chris Grove, Director of Cybersecurity Strategy, Nozomi Networks (2026).

### The Future Forecast

Manufacturing faces a sustained cycle of cyber attacks, where disruption is targeted and increasingly systemic. The sector was the most targeted industry for the fifth year in a row, accounting for 27.7% of all incidents (IBM, 2026), while manufacturers represented 68% of all industrial ransomware incidents in 2025 (Dragos, 2025). Supply chain attacks are also rising, up 20% year-on-year, as legacy systems and interconnected partner networks expand the attack surface (IDS-INDATA, 2025).

This is reshaping how security is designed and managed. As information technology (IT) and operational technology (OT) converge, static controls and one-off assessments are being replaced by continuous testing and validation. Telstra found that 70% of OT systems are expected to connect to corporate IT networks by next year, yet only 19% of manufacturers are considered advanced in securing IT/OT environments (Telstra International, 2025).

In response, digital twins are emerging as a new security layer, allowing companies to model systems, simulate attack paths and test defensive responses without putting live operations at risk. By 2029, 75% of large manufacturers will use AI-enabled OT cyber defence, cutting detection times by 60% (IDC FutureScape, 2025).

### Pioneers in Action

- Global AI security leader TrendAI has created digital twin environments for AI infrastructure, enabling organisations to design and validate security architectures before deployment. By simulating network configurations, system interactions and threat scenarios, teams can test how security controls perform under real-world conditions without exposing live systems. This approach allows vulnerabilities to be identified early, defensive measures to be stress-tested and system resilience to be optimised in advance. It also signals a shift towards design-led security, where cyber risk is modelled, measured and mitigated before systems go live.

- AI-native OT penetration testing platform Frenos has developed a digital twin of operational technology environments, allowing manufacturers to simulate cyberattacks, map attack pathways and test defensive strategies without disrupting production. By combining virtual replicas with AI-driven analysis, organisations can continuously assess vulnerabilities, predict potential threats and prioritise mitigation actions based on operational impact. This enables a move away from periodic risk assessments towards continuous, simulation-based security validation. The model reflects a broader shift in industrial cybersecurity, where resilience is built through ongoing scenario testing rather than reactive response.

### Strategic So What?

Security is shifting from reactive defence to continuous validation, where resilience is designed, tested and proven before disruption occurs.

For greater protection:

- Build simulation environments that mirror critical systems, enabling safe testing of attack scenarios and response strategies.
- Integrate security across IT, OT and supply networks to identify vulnerabilities across the full operational ecosystem.
- Embed continuous testing and validation into operations, moving from periodic assessment to ongoing assurance.

Continuous validation strengthens resilience, enabling manufacturers to anticipate threats, contain disruption and protect operations before impact.

# Made Closer

## Is cheap distance still worth the risk?

Distance is losing its advantage. Manufacturers are rethinking where production should sit, not only to cut lead times but to protect continuity, strengthen control and reduce exposure to external shocks. The next era of competitiveness will depend less on how far supply chains can stretch and more on how securely regional ecosystems can hold.

> "The reality is that the world where open borders and free trade could be considered as givens – with no weaponisation of that and no risk to your supply chain – is over."
>
> Nicolas Piau, CEO, Tilt Capital (2026).

### The Future Forecast

Manufacturing is reorganising around regional strength, where resilience, market access and strategic control matter as much as labour cost. Reindustrialisation is accelerating across Europe and the UK as companies reassess the risks of long, fragmented supply chains and governments move to secure critical industrial capacity. The focus is shifting from cost optimisation to risk management, with production increasingly positioned closer to end markets to improve responsiveness, reduce exposure to disruption and strengthen supply continuity.

In 2025, 66% of executives said they already had or were developing a reindustrialisation strategy, 56% had invested in nearshoring, and 73% expected friendshoring to represent a significant share of future sourcing and production (Capgemini, 2025). This signals a structural shift in how supply chains are designed. Over the next three years, offshore manufacturing is expected to fall from 37% of facilities to 28%, while onshore operations rise from 41% to 48% (Capgemini, 2025), reflecting a rebalancing of global production footprints.

Policy is also reinforcing change. The European Commission's proposed Industrial Accelerator Act aims to raise manufacturing's share of EU GDP from 14.3% in 2024 to 20% by 2035 through stronger demand for European-made strategic products and tighter conditions around foreign investment (IAA, 2026). In the UK, 63% of manufacturers say they will source more materials domestically over the next five years (Make UK x DHL Express, 2026), further accelerating the move towards more regionalised, resilient production systems.

### Pioneers in Action

- Siemens is investing more than €200 million in a new AI-based, highly automated factory in Amberg, Germany, reinforcing domestic production capacity for critical industrial technologies. The investment strengthens national industrial capability while increasing flexibility and long-term resilience – highlighting how advanced manufacturing is being embedded within core markets to secure strategic control.

- Apple is shifting part of its Mac Mini production from Asia to the US, expanding manufacturing in Texas as tariffs and geopolitical pressure reshape its supply chain. While limited in scale, the move signals a broader shift: even highly globalised manufacturers are rebalancing production footprints to manage risk and retain greater operational control.

- Swedish car manufacturer Polestar is bringing production of its Polestar 7 model to Europe, positioning manufacturing closer to its primary customer base. By aligning production with demand, the company is improving responsiveness, reducing lead times and strengthening regional delivery models – highlighting how proximity is becoming a competitive advantage in a more fragmented global landscape.

### Strategic So What?

Manufacturing location is becoming a strategic decision as resilience, control and proximity redefine competitive advantage.

To succeed:

- Redesign supply chains around regional hubs, balancing onshore, nearshore and partner networks to reduce exposure to disruption.
- Invest in automation and digital capabilities to offset higher local production costs and maintain competitiveness.
- Align production with demand by placing capacity closer to key markets to improve speed, flexibility and service.

Positioning production closer to demand, supported by resilient ecosystems, gives manufacturers greater control, responsiveness and long-term stability in an increasingly fragmented global economy.

# Self-Healing Chains

## Can supply chains correct themselves before disruption hits?

Supply chains are evolving into decision-making systems. Instead of relying on human-led planning and response, networks are being designed to detect disruption, simulate impact and adjust flows automatically. Intelligence is being embedded to execute them, enabling supply to correct itself in real-time.

> “What we see emerging is a supply chain model that is smarter, more connected and increasingly powered by AI. This transition isn’t just about efficiency; it’s about enabling sustainable, profitable growth by redesigning how organisations operate end-to-end.”
>
> Mattias Hansson Director and Head of Customer & Operations, KPMG Sweden (2026).

### The Future Forecast

Supply chains are being rebuilt for a world of constant disruption. Volatility is no longer episodic – it is structural, with geopolitical fragmentation, climate shocks and infrastructure strain reshaping how goods move globally. In Europe, 43% of firms report losing more than a month of operational time during major disruption, while 30% incur annual costs exceeding $1 million (DP World, 2026).

This pressure is accelerating the shift towards intelligent, adaptive systems. AI-led supply chains are already delivering measurable gains, including up to 25% shorter lead times, 35% lower inventory levels and 15% lower logistics costs (World Economic Forum, 2026). As well as this, 82% of organisations plan to increase investment in AI, robotics and automation in logistics over the next three years (DP World, 2026).

Supply chains are becoming intelligent networks that continuously rebalance flow, risk and performance before disruption is felt. Digital twins and AI-driven control towers allow companies to simulate disruption, test responses and adjust operations in real-time. Organisations using these capabilities are achieving up to 28% faster recovery following supply chain shocks (Gartner, 2025).

### Pioneers in Action

- Siemens uses digital twin environments to model more than 500 live production scenarios daily, combining real-time sensor data, supplier lead-time variability and transport risk probabilities. This allows the company to reallocate resources before bottlenecks hit operations, reducing downtime by around 20% and logistics cost volatility by 14%. It is a strong example of a supply chain moving from monitoring disruption to pre-empting it.

- Toyota has built a centralised resilience intelligence hub that combines supplier, commodity and logistics data to detect early warning signs across its network. In one case, it identified risk at a semiconductor supplier six weeks before disruption occurred, allowing orders to be shifted early and helping avoid a major production shortfall.

- Schneider Electric uses a cognitive supply chain platform to generate early warnings, model scenarios and recommend actions across its network. During the Red Sea crisis, the system flagged risk through external data and lead-time deviations, enabling teams to validate and execute alternative sourcing and logistics options within hours rather than days.

### Strategic So What?

Supply chains that can detect, decide and act autonomously will redefine how resilience and performance are delivered at scale.

Strategies require:

- Building unified, real-time data foundations that connect suppliers, production and logistics into a single operational view.
- Embedding AI and simulation capabilities to enable continuous scenario testing and dynamic decision-making.
- Establishing closed-loop execution, where insights trigger automated adjustments across sourcing, inventory and distribution.

As supply chains continuously sense and self-correct, disruption shifts from an operational risk to a managed variable.

# Re-Engineering Talent

## Is manufacturing losing the talent it needs?

Manufacturing is constrained by workforce readiness. As production becomes more intelligent, performance depends on people who can operate, adapt and improve complex systems. Workforce capability directly determines how industrial systems run, adapt and scale.

> "Young people today are confident, creative problem solvers and full of potential. They have the skills that modern manufacturing needs, but there's a perception gap we need to close."
>
> Richard Watson, CEO, Nestlé UK & Ireland (2026).

### The Future Forecast

A structural gap is emerging between current workforce capability and future demand. In the UK, 48,000 manufacturing roles remain unfilled, costing £6 billion in lost output each year (Make UK X PwC, 2026), while nearly 40% of core skills are expected to change by 2030 (World Economic Forum, 2025). As production becomes more automated, data-driven and interconnected, the nature of work is shifting faster than the workforce can adapt, creating pressure across both frontline and technical roles.

The challenge also affects future talent. Manufacturing is competing for attention in a market where perception shapes career choice, yet awareness of modern roles remains low. While 59% of young people find the sector interesting, only 4% would consider a career in it (Nestlé, 2026), highlighting a disconnect between interest and intent. Manufacturers are responding by investing in apprenticeships, education partnerships and alternative entry routes to improve access and attract new talent.

Workforce capability is becoming a core strategic priority. Continuous, technology-enabled learning is being built into operations, supported by AI, immersive training and real-time knowledge tools. These approaches enable workers to operate complex systems, interpret data and improve performance in real-time, while sustained investment supports the transition into more technology-driven roles.

### Pioneers in Action

- Bosch has trained more than 130,000 employees worldwide in data analytics, automation and connectivity, embedding continuous learning into its operating model. The programme combines technical training with cultural transformation, positioning workforce development as a long-term capability rather than a one-off intervention. It shows how talent is being systematically re-engineered to support AI-enabled manufacturing at scale.

- Jaguar Land Rover is investing $25 million annually to reskill production workers for technology-driven roles, supporting the shift from manual tasks to system oversight and optimisation. The programme focuses on enabling employees to transition into future roles shaped by AI and automation. It highlights how workforce transformation is becoming a continuous, funded priority rather than a reactive response to change.

- Austrian electronics manufacturer Flex has re-engineered its talent pipeline at its Althofen site, where competition for skilled labour is intensified by its rural location. It has expanded apprenticeships, increased intake by 20% and opened pathways for non-traditional entrants. By combining early education partnerships with clear career progression, Flex is strengthening attraction, engagement and long-term workforce resilience.

### Strategic So What?

Workforce capability is becoming a defining constraint on industrial performance, requiring a more systematic approach to how talent is built, deployed and sustained.

Manufacturing leaders should:

- Invest in continuous, embedded learning systems that develop capability alongside evolving operations.
- Build structured talent pipelines through apprenticeships, partnerships and alternative entry routes to secure future skills.
- Align workforce strategy with technology investment to ensure people can operate, adapt and optimise intelligent systems.

To build a future-ready workforce, manufacturers must design and sustain workers that can operate intelligent production systems.



"Workforce capability in data-driven manufacturing depends on embedding learning directly into day-to-day operations."

Kath Brameld, Manufacturing Industry Director, Oracle NetSuite (2026).

# Humanoid Workforce

## What if robots controlled the factory?

Physical work is becoming programmable. AI is being embedded in machines that can act, lift and learn, integrating intelligence directly into physical tasks. Humanoid robots and wearable systems are reshaping labour, combining human and machine capability to extend how work is performed.

> Adoption of humanoids is likely to accelerate in the late 2030s with improved technology as well as greater regulatory and societal support. The global market is expected to surpass $5 trillion by 2050.
>
> Morgan Stanley (2025) Humanoids: A $5 Trillion Market.

### The Future Forecast

Physical AI is entering real production environments. The cost to create robotics are falling quickly, with humanoid robots dropping around 40% in a year to between $30,000 and $150,000 per unit (Goldman Sachs, 2024). The humanoid market is projected to reach between $38 billion and $66 billion by the early 2030s (Fortune Business Insights, 2026), signalling growing commercial momentum.

Manufacturing is becoming the primary testing ground for these robotics. Early use cases centre on repetitive and physically demanding tasks, where humanoids can deliver consistent performance over time. These deployments are establishing how robots operate alongside people within existing environments, using the same tools and workflows.

Advances in AI are accelerating progress. Robots can learn tasks more efficiently and adapt to different conditions, expanding the range of work they can perform. As capability improves, machines will take on a greater share of physical tasks across production.

This shift is already visible in wearable robotics, which is scaling faster and delivering immediate impact. The exoskeleton market is expected to grow from $3.37 billion to $13.52 billion by 2030 (Mordor Intelligence, 2026), as manufacturers invest in reducing strain and extending workforce capability.

### Pioneers in Action

- BMW is deploying humanoid robots at its Leipzig plant to support assembly and battery production, following successful trials in the US. The robots handle physically demanding, repetitive tasks such as component placement, operating in real production environments and shifts. The programme focuses on integrating AI-enabled robots into live systems, signalling early adoption of embodied AI in industrial settings.
- Mercedes-Benz is testing humanoid robots in its factories for tasks such as moving components and quality checks. Using teleoperation, robots learn tasks from human workers and build towards autonomous execution. The trials show how embodied AI can be trained directly within production environments, enabling robots to adapt to real workflows rather than requiring redesigned systems.
- Hyundai has introduced its X-ble Shoulder exoskeleton to support assembly line workers performing repetitive overhead tasks. The lightweight, non-powered device reduces shoulder load by 60% and muscle activity by 30%, improving safety and efficiency. It shows how wearable robotics are scaling as a practical solution to extend human capability within industrial environments.

### Strategic So What?

Labour is becoming a combination of human and machine capacity, changing how work is designed and delivered across production.

Leaders should:
- Define which tasks are best suited to people, machines or a combination of both.
- Adapt workflows and environments to support seamless human-machine collaboration.
- Build capability to operate, train and manage intelligent machines as part of the workforce.

Competitive advantage will depend on how effectively organisations combine human and machine performance into a single workforce.

# 03 Engineered Value

- Power Shift
- Traceable Transparency
- Access Models
- Materials 4.0
- Made On-Demand

# Power Shift

## Who powers the future factory?

Factories are using more energy than ever before. Rising costs, supply instability and increasing power demand are forcing manufacturers to rethink how production is powered. This is influencing how factories are designed, run and scaled.

Only 38% of leaders surveyed believe their current energy infrastructure can meet evolving needs over the next five years.

PwC (2025) The Future Of Energy & Manufacturing.

### The Future Forecast

Energy is placing new limits on how quickly and efficiently industrial operations can scale. As factories become more automated, electrified and data-intensive, power demand is rising within the production environment, while external energy systems grow more volatile and expensive. Nearly 90% of UK businesses have seen energy costs increase in recent years, with 40% cutting investment as a result (CBI x Energy UK, 2026).

In response, manufacturers are rethinking how energy is managed. Power is becoming a capability to secure and optimise. Only 38% of industrial leaders believe their current energy infrastructure can meet future needs, while 80% plan to increase investment in energy resilience within three years (PwC, 2025). On-site generation, storage and intelligent energy systems are becoming more important as manufacturers look to improve continuity, reduce exposure to price volatility and support growing electricity demand.

In the future, energy will be designed into the factory itself. 83% of UK manufacturers plan to invest in green technologies, with renewable energy the top priority (Make UK, 2025). Factories will operate as energy systems, where the ability to generate, store and optimise power becomes critical to performance, resilience and long-term competitiveness.

### Pioneers in Action

- UK manufacturer Delta Fire has accelerated its shift towards energy independence by doubling its solar capacity and installing a 300kWh battery. The system enables the business to operate as energy self-sufficient for up to eight months of the year, while exporting surplus power back to the grid, demonstrating how manufacturers can reduce reliance on external supply.

- In partnership with AMP Clean Energy, UK malt producer Simpson's Malt has deployed a hybrid energy system at its Tweed Valley site, combining biomass boilers with a UK-first electric boiler powered by surplus wind energy. The system delivers consistent low-carbon heat, reduces reliance on fossil fuels and cuts 25,000 tonnes of $CO_2$ annually while improving control over energy supply.

- British Sugar is integrating energy generation directly into production at its Wissington site, investing £43m in steam dryers powered by its on-site CHP (Combined Heat and Power) plant. The system improves energy efficiency and reduces emissions by 80,000 tonnes, showing how large-scale manufacturing sites are redesigning operations to manage and optimise energy use more effectively.


## Strategic So What?

Energy is becoming a core capability that directly shapes industrial performance, resilience and growth.

To stay ahead:

- Secure cost advantage through on-site generation, storage and diversified energy sourcing.
- Optimise energy use in real-time to reduce waste, improve efficiency and protect margins.
- Build resilience into energy systems to maintain continuity and reduce exposure to price volatility.

Manufacturers that actively manage and control energy will reduce risk, improve efficiency and unlock more resilient, competitive operations.

# Traceable Transparency

## What happens when products carry their own data – and their own proof?

Digital Product Passports (DPP) are turning manufactured goods into traceable assets, carrying verified information on what they contain, where they come from and how they can be repaired, reused or recovered. As this data becomes mandatory and more visible, transparency will shift from compliance task to source of competitive advantage.

> "Trusted product data will determine how efficiently businesses operate, how confidently they comply and how effectively they grow."
>
> Kath Brameld, Manufacturing Industry Director, Oracle NetSuite (2026).

### The Future Forecast

From 2027, the EU will begin phased rollout of DPP requirements across priority product groups, with broader expansion expected by 2030, creating a common digital information layer across products and supply chains (KPMG, 2026). This will push manufacturers to capture more detailed lifecycle data, from material composition and carbon footprint to repair, reuse and end-of-life pathways.

Adoption is currently constrained by unclear ownership and limited understanding of how to implement DPPs in practice. While 97% of companies surveyed say they have heard of DPPs, only 33% report a high understanding of what the requirements mean for their business, and 23% still have no clear ownership assigned internally (KPMG, 2026). Successful adoption will depend on coordinated data flows across suppliers, factories, logistics and service networks.

As these gaps are addressed, early value is beginning to emerge across circular models and product demand. One in three companies expects DPPs to unlock new models such as repair, resale and product-as-a-service, while 36% expect stronger demand for products with better sustainability performance (KPMG, 2026). The market is set to scale quickly, growing from $275 million in 2025 to $2 billion by 2033 (Grand View Research, 2026). Product transparency will become core infrastructure for compliance, customer trust and circular value creation.

### Pioneers in Action

- Leading manufacturers, including chemical producer BASF and BMW, have launched Path.Era, a digital battery passport platform that tracks lifecycle data across the battery value chain. Each battery carries a digital record of material composition, carbon footprint and recycling data, enabling manufacturers to improve traceability, meet regulatory requirements and support circular production.

- Siemens is developing digital product passports for industrial equipment, giving each product a QR-linked digital identity that tracks production, maintenance, refurbishment and end-of-life data. The system uses Asset Administration Shell (AAS) – a digital twin – and distributed ledger technology to support EU traceability and sustainability requirements, enabling secure data sharing and extending product life through refurbishment.

- The National Manufacturing Institute Scotland (NMIS) is piloting digital product passports for remanufacturing, embedding detailed material, process and lifecycle data into industrial components such as compressors. By integrating DPPs into ERP and production systems, manufacturers can enable repair, reuse and service-based models while capturing additional value from products over time.

### Strategic So What?

Transparency is becoming a condition of market access and a driver of differentiation.

Leaders should:

- Design products with data in mind, ensuring materials, lifecycle and recovery pathways are defined and captured from the outset.
- Build connected data flows across suppliers and systems to create a single, trusted view of each product's history.
- Turn transparency into value by enabling repair, resale and service models that extend product life and deepen customer relationships.

Manufacturers that build transparency into their operations will strengthen market access, unlock new revenue streams and compete on trust as well as performance.

# Access Models

## What happens when ownership stays with the manufacturer?

Manufacturers are retaining ownership of what they produce. Instead of selling assets outright, they provide access to performance over time, bundling equipment with data, maintenance and guarantees. Customers are paying for outcomes rather than products, creating ongoing relationships where value builds through usage, insight and continuous improvement.

> "Delivering outcomes instead of products requires intelligence embedded directly into operations. When assets, data and workflows are connected, performance becomes something that can be managed, measured and refined."

Kath Brameld, Manufacturing Industry Director, Oracle NetSuite (2026).

### The Future Forecast

Access models are gaining traction as manufacturers look for more resilient and scalable ways to grow. Revenue from outcome-based services is expected to rise from 25% to 41% within five years, signalling strong momentum behind performance-led business models (Syncron, 2025). As this develops, more than 44% of industrial revenue is projected to come from activities beyond traditional product sales by 2030, as services, data and ongoing relationships take a larger role (PwC, 2026).

This is reshaping how assets are designed and monetised. Equipment is being built for longevity, upgradeability and reuse, with manufacturers retaining control across the lifecycle. The Equipment-as-a-Service market is projected to grow from $1.5 billion in 2023 to $27.8 billion by 2030, highlighting how quickly access-based models are scaling across industries (Grand View Research, 2024).

Manufacturers will hold more of the asset, the data and the long-term value, while customers will carry less risk, less upfront cost and less responsibility for maintenance and performance. As this model expands, revenue becomes continuous, products remain in use for longer and control concentrates with those able to manage assets, outcomes and relationships at scale.

### Pioneers in Action

- US-based manufacturer Divergent Technologies is redefining production through a Factory-as-a-Service model, where customers access manufacturing capacity without owning infrastructure. Its software-defined, vertically integrated system produces complex aerospace and automotive components on demand, enabling rapid iteration and scalable output. By retaining ownership of the production platform, Divergent continuously improves performance, efficiency and cost. This shifts manufacturing from a fixed asset to a flexible service layer, where capability is accessed as needed and value is delivered through speed, adaptability and ongoing system optimisation.

- Based in London, manufacturer Geomiq is transforming custom manufacturing through an AI-powered Manufacturing-as-a-Service platform that connects businesses to a global supplier network. Engineers upload designs and access production across CNC machining, 3D printing and injection moulding without managing suppliers directly. This removes the need to own production capability, shifting manufacturing from a fixed investment to an on-demand service. By orchestrating capacity through a digital platform, Geomiq enables faster lead times, greater flexibility and more efficient procurement in a model where access replaces ownership.



## Strategic So What?

Control over assets, data and performance will define competitive advantage as value shifts into ongoing usage, service and lifecycle delivery.

Leaders should:

- Design products for lifecycle ownership, prioritising durability, upgradeability and recovery.
- Build service capabilities that combine hardware, data and ongoing performance into integrated offerings.
- Develop commercial models that monetise usage, outcomes and continuous improvement across the asset lifecycle.

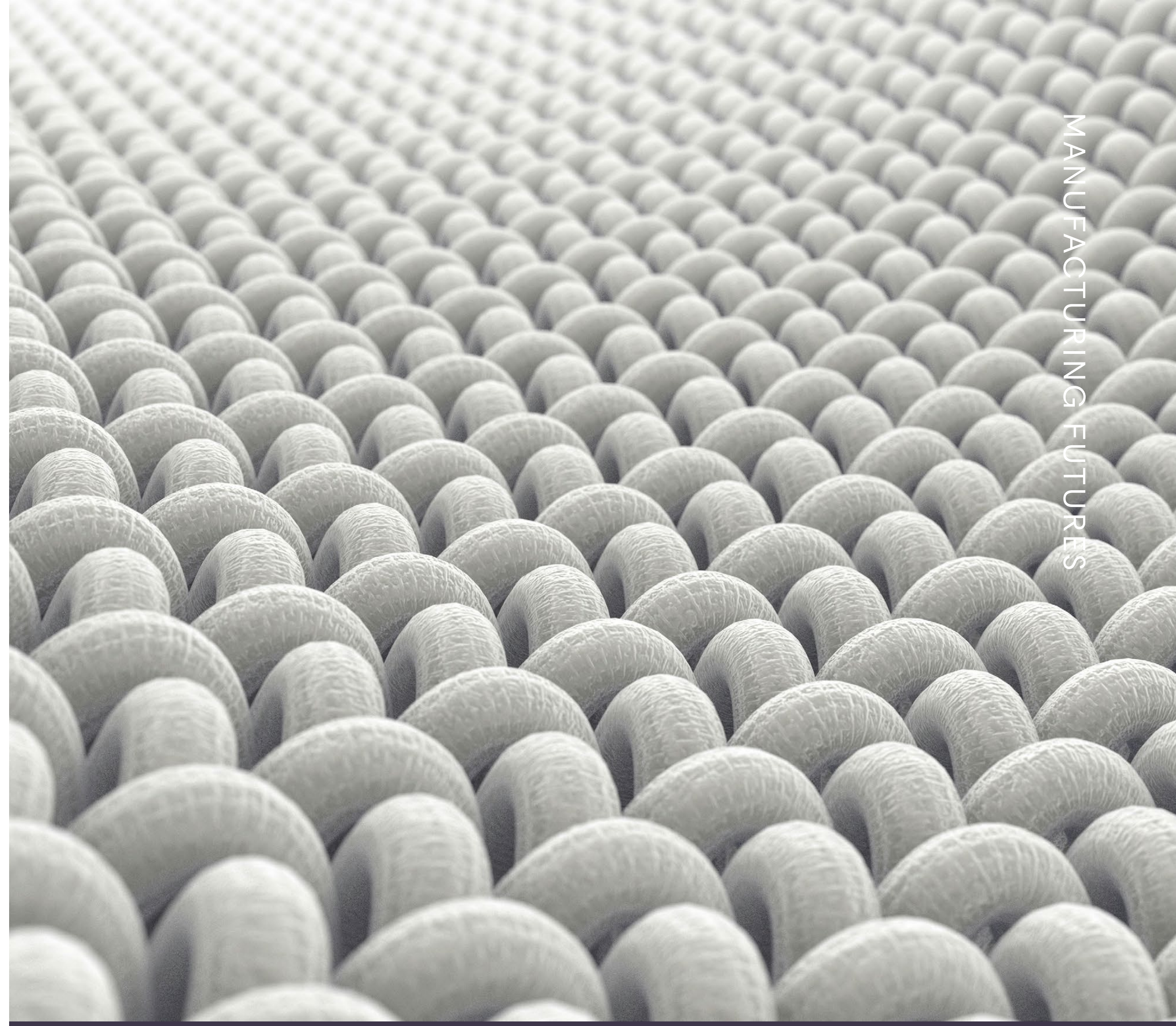
Retaining ownership and delivering performance over time allows value to compound across the lifecycle, strengthening revenue, resilience and control.

> "Servitization changes the game. It monetises AI and digital technologies, deepens customer relationships, builds recurring revenue, enables the circular economy, and shifts competition from price to value in use."

Tim Baines, Professor of Operations Strategy at Aston University (2026).

# Materials 4.0

## Will materials define the next era of industrial progress?



Materials are becoming a defining lever of manufacturing performance. What products are made from is shaping how they are produced, how they perform and how long they remain in use. As materials are engineered for specific outcomes, they are setting the boundaries of efficiency, durability and what manufacturing systems can achieve.

> The UK's Modern Industrial Strategy highlights Advanced Materials as one of six "frontier manufacturing industries" with the greatest growth potential.

The Henry Royce Institute (2025).

### The Future Forecast

Manufacturing performance is being shaped earlier in the value chain, as material innovation begins to define what production systems can achieve. In the UK, advanced materials already contribute around £45 billion annually and support over 630,000 jobs, with demand expected to at least double by 2035 (Henry Royce Institute, 2025). This reflects a shift in how performance is created, moving closer to the design of what products are made from.

Development cycles are accelerating as AI, simulation and data-driven modelling reduce the time required to discover, test and validate new materials. This is allowing materials to be engineered with specific production and performance requirements in mind, improving how they behave within manufacturing processes and how efficiently they can be produced at scale. Investment in skills and capability is expanding in parallel, with initiatives such as the European Advanced Materials Academy aiming to train 200,000 specialists by 2029 (European Commission, 2025).

As a result, materials are becoming a core part of how manufacturing systems are configured and optimised. Decisions made at the material level are increasingly shaping throughput, durability and resource use, defining how products are built and how long they remain viable in use.

### Pioneers in Action

- London-based Materials Nexus is using AI and machine learning to develop rare-earth-free magnetic alloys for energy and electronics. Working with the Henry Royce Institute, it has already produced and validated a sample material, showing how digital tools can accelerate discovery, reduce supply-chain risk and speed the path from material design to industrial application.

- Material innovation company Cecilia is turning industrial plastic waste into high performance carbon materials, including carbon nanotubes for aerospace, defence and electronics manufacturing. Instead of downcycling waste, it is creating materials with strategic industrial value, showing how advanced materials innovation can strengthen circularity, reduce reliance on virgin inputs and rebuild supply chains around higher-value outputs.

- US materials company Soarce is developing a nanocellulose material made from organic waste and seaweed that is reported to be eight times stronger than steel. Already used in automotive and aerospace manufacturing, it shows how next generation biomaterials can combine high performance with lower-impact inputs and open new possibilities for lighter, stronger industrial materials.

## Strategic So What?

Manufacturing performance is increasingly determined at the point of material design, requiring closer integration between material innovation and production systems.

For success:

- Embed material expertise earlier in product and process design to influence performance, cost and lifecycle outcomes from the outset.
- Align material selection with manufacturing capabilities to optimise throughput, energy use and durability at scale.
- Develop the ability to test, validate and deploy new materials quickly, reducing the gap between discovery and industrial application.

Value compounds across the lifecycle, strengthening revenue, resilience and control through retained ownership and sustained performance.

# Made On-Demand

## What if we only made what was needed?

Additive manufacturing is redefining how and why things are made, enabling manufacturers to produce specific parts only when demand is confirmed. This reduces excess stock, limits wasted material and shifts production from forecast-led planning to a more precise, demand-driven model built around real-world need.

> "With traditional methods, every new design might mean a new mold. Here, your molds are digital. You can change them instantly."
>
> David Mazo, Aerospace Engineering Group Lead, HP Additive Manufacturing (2025).

### The Future Forecast

Additive manufacturing is entering a more industrial phase, with stronger relevance in areas where conventional processes struggle to balance cost, complexity and speed, particularly in low-volume, high-complexity parts and customised production. The global additive manufacturing market is projected to reach $70 billion to $88 billion by 2030, with end-use parts expected to make up 38% of output, signalling a broader move from experimentation into production-scale use (Grand View Research, 2026).

The environmental impact of additive manufacturing is becoming both measurable and commercially relevant. It can significantly reduce emissions, material use and energy consumption compared with traditional processes, with one textile example cutting $CO_2e$ emissions by 24.8% and material use by nearly 50% (Stratasys, 2025). Industrial policy is also accelerating adoption. The EU is aiming to double its circularity rate to 24% by 2030, increasing pressure on manufacturers to recover more value from materials and design for reuse at scale (European Commission, 2026).

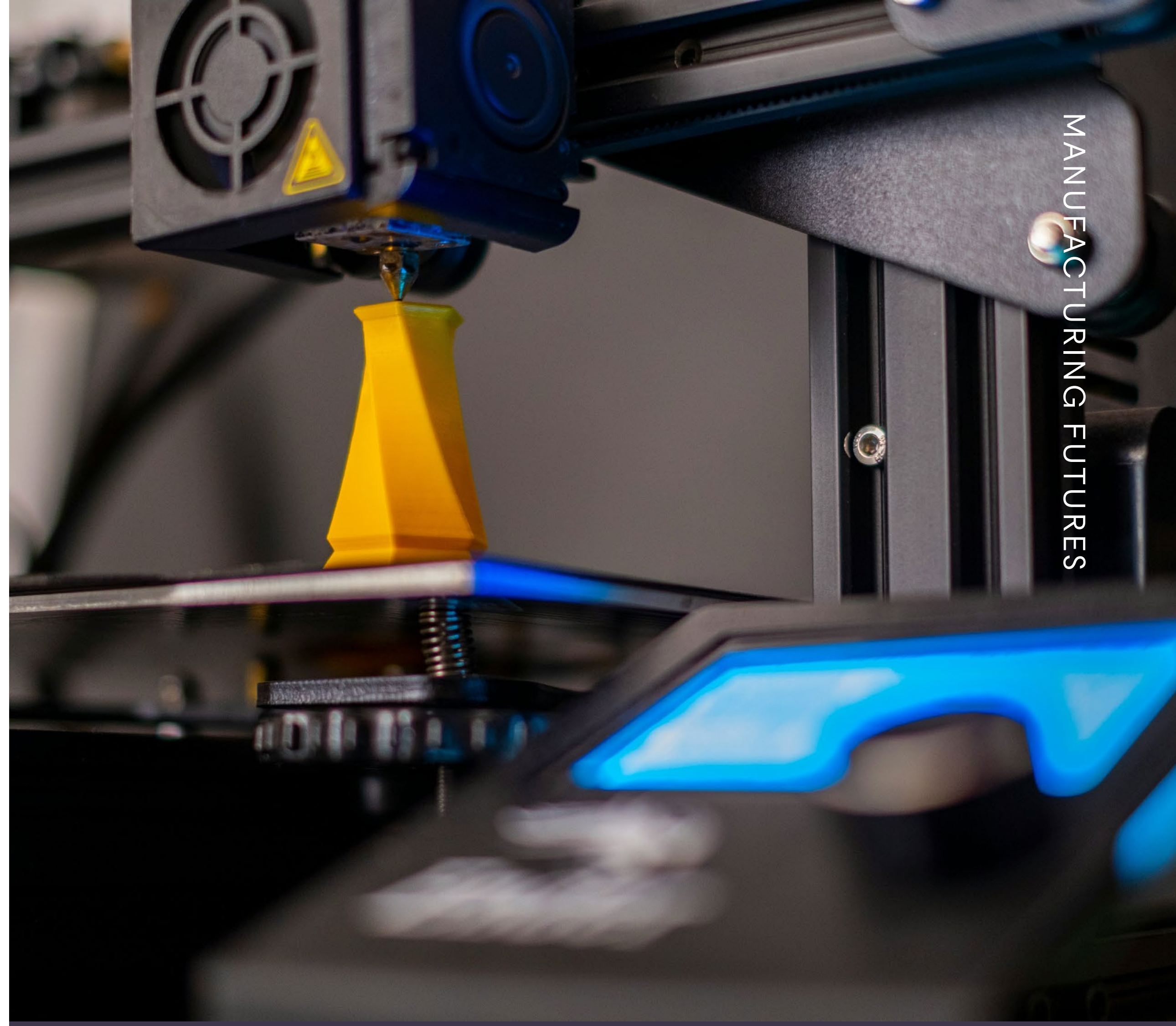
Over the next decade, this will extend additive manufacturing beyond speed and flexibility alone. Its role will expand into enabling production systems that are digitally distributed, materially efficient and increasingly responsive to real demand signals. As this model scales, manufacturing shifts from maximising output to ensuring every unit produced meets a defined commercial and environmental need.

### Pioneers in Action

- Dutch lighting manufacturer Signify has built a global network of additive manufacturing hubs producing customised luminaires on demand. Through its myCreation platform, products are configured digitally, printed near demand, and made using recycled and bio-circular materials. With 3.5 million luminaires produced, the model reduces inventory, transport and waste while showing how local, digital production can scale commercially.

- BMW is using additive manufacturing to produce tools, fixtures and components on demand across its production network using recycled filament made from waste powder and discarded parts. Every BMW plant now has 3D printing capability, allowing teams to respond quickly to operational needs without holding excess stock. The model combines local fabrication with material reuse, showing how additive manufacturing can support both agility and circularity inside live manufacturing environments.

- Technology manufacturer HP shows how additive manufacturing can turn production into a digital, distributed system. In HP's drone manufacturing, full airframes can be printed in as little as 12 to 24 hours, with designs shared securely and produced locally without tooling or factory reconfiguration. This enables lighter, more adaptable products and a more agile supply model, where manufacturing can scale with demand and shift closer to the point of need.





## Strategic So What?

Production models built around precision, flexibility and material efficiency will redefine how value is created across manufacturing.

To succeed:

- Design products and components specifically for additive processes to unlock efficiency, performance and material savings.
- Shift from physical stock to digital inventory, enabling faster, more responsive production without excess holding costs.
- Build distributed production capabilities that bring manufacturing closer to demand and reduce reliance on complex supply chains.

Production driven by need rather than volume reduces waste, improves responsiveness and strengthens operational resilience and efficiency.

# Conclusion

## The next era of manufacturing

Manufacturing is moving beyond a model centred on output and efficiency. It is evolving into a system built on intelligence, resilience and value, where performance is measured across the full lifecycle of products, operations and supply networks.

Production is becoming more responsive, with systems able to sense conditions and operate with greater precision. Supply chains are being reconfigured to absorb disruption and maintain continuity. Value is also expanding, with energy, materials, transparency and access shaping how products are created, delivered and sustained.

The three pillars of manufacturing's future – Intelligent Production, Industrial Resilience and Engineered Value – provide the structure for this shift. Together, they define a model where systems operate with greater awareness, operations adapt more effectively and value is created with greater control and consistency.

The priority now is execution. Manufacturing leaders need to connect these elements into a coherent operating model, with clear visibility across production, supply and service. Data, workflows and decision-making must align to enable faster responses, stronger coordination and more predictable outcomes.

At Oracle NetSuite, we see that leading organisations focus on how systems connect, not just how they perform. Integration is what turns capability into sustained performance.

Manufacturing is entering a more system-driven phase. Those that align intelligence, resilience and value into how they operate will define the next standard of performance.

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