



Harnessing value from manufacturing data

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Introduction

For decades manufacturing excellence meant precision, repeatability, and control, while focusing on cost efficiency. Processes were optimised, machines calibrated, and operators trained to maintain strict consistency. But as global disruptions accelerate, supply chains diversify, and customers demand speed and personalisation, the paradigm is shifting.

Today, competitive advantage is increasingly defined not by how well a factory runs, but by how well it learns and how quickly it can act on what it learns. The modern factory is no longer just a mechanical system. It is a system of data, people and machines. And the manufacturers that can capture, connect, and act on that data are redefining what operational excellence means.



The hidden power of operational data

Every component, every sensor, every batch generates data. Yet, in many facilities, this data remains locked in machines, spreadsheets, or siloed systems—untapped, untrusted, or underutilised.

Operational data holds the key to unlocking efficiency, optimising the supply chain and increasing product and process innovation. Performance anomalies, quality drifts, and unplanned downtime often reveal themselves first as subtle patterns—in temperature fluctuations, shift timings, or micro stops in production lines. When these signals are captured and analysed early, they become powerful levers for action.

Consider a plant struggling with variable yield. Traditional methods often require cumbersome, one-off analyses to pinpoint the root causes before any process adjustments can be made. By contrast, a data-driven approach might reveal, for example, that subtle temperature instabilities in a specific shift, combined with changes in raw material moisture, are the culprits. Insights of this kind are only discoverable through pattern recognition at scale.

The value of data lies not only in continuous monitoring and diagnosis, but also in orchestration. When inventory data connects with production planning and customer demand, lead times shrink. When maintenance data connects with supply availability, spare parts arrive before machines fail. Value emerges when data is leveraged meaningfully.

The foundations for data-driven success

Advanced data solutions do not deliver value without strong digital foundations. For manufacturers, the journey to data-driven value must begin with architectural clarity and transactional integrity, combined with solid security.

This starts with **robust core systems**: Enterprise Resource Planning (ERP), Manufacturing Execution Systems (MES), and Quality Management Systems (QMS) must operate cohesively and accurately. These form the nervous system of the factory, generating structured, time-stamped, trusted data.

Beyond systems, **data governance** becomes essential. Without standardised formats and definitions, consistent naming conventions, and master data management, insights become fragmented. Data ownership is crucial in highlighting who is responsible for maintaining and improving data products. Data must be contextualised—linked to products, processes, batches, and equipment—so that what is analysed is truly understood.

Integration is the third pillar. Data from OT systems – Programmable Logic Controllers (PLCs), supervisory control and data acquisition (SCADA), and sensors – must connect seamlessly with IT systems (ERP, analytics platforms). Without this integration, manufacturers risk building digital islands – technically advanced but strategically disconnected.

Finally, **quality, traceability, and security** must be embedded—not bolted on. In modern manufacturing environments, where processes span cleanrooms, GxP (Good Practice guidelines) compliance, and IoT-connected equipment, data must be protected and traceable by design. This means implementing safeguards such as encryption, access control, and digital audit trails to ensure visibility, accountability, and cyber-resilience from the ground up.

In highly regulated industries, auditability is not a nice-to-have, it is essential for product release, regulatory compliance, and market access. But even outside the pharmaceutical industry, manufacturers increasingly recognise the value of **data integrity**: the ability to trust that data is complete, accurate, consistent, and unaltered throughout its lifecycle. This underpins everything from predictive maintenance to automated decision-making.

Yet integrity alone is not enough. Without clear **data governance, ownership, and stewardship**, organisations risk obtaining fragmented insights, duplicate efforts, and analytics that never scale. Only when these foundational elements are in place can advanced analytics and AI move from promising pilots to sustainable, enterprise-wide transformation.



Robust Core Systems



Data Governance



Integration



Quality, traceability, and security



Data integrity



Data governance, ownership, and stewardship

Accelerating value with AI and advanced analytics

Once the foundations are secured, manufacturers can unlock a new level of performance through the use of artificial intelligence. AI augments the ability to spot patterns, anticipate deviations, and act proactively.

Predictive maintenance is often the starting point. By analysing vibration, thermal, and run-time data, AI models can forecast equipment failure before it happens—transforming reactive repair into planned intervention. This not only reduces downtime, but stabilises production schedules and protects margins. Agentic AI takes this further by autonomously triggering maintenance workflows, coordinating with supply chain systems to order parts, and scheduling technician availability – all without human intervention.

In quality control, computer vision systems can now sometimes surpass human inspectors in consistency and speed. AI-powered cameras detect surface defects, colour mismatches, or micro-contaminants in milliseconds—enabling real-time corrections.

Even planning and logistics benefit. AI can dynamically adjust production schedules in response to real-time inventory, supplier delays, or order changes. In highly complex operations, reinforcement learning algorithms are beginning to orchestrate entire process chains for optimal flow.

But AI is only as good as the data it learns from. If foundational systems are unreliable or disconnected, AI becomes a theoretical tool with no practical application. That is why successful manufacturers treat AI not as a solution that can be bought but as a capability that must be built—layered onto sound systems, governed data, and clear business priorities.

Designing for business value

Harnessing data is fundamentally a strategic exercise. Manufacturers have the opportunity to rethink how they align digital investments with measurable business outcomes.

The most successful strategies begin with clarity about the business value. Before deploying any data initiative, organisations must define: What business problem are we solving? How will this data product support a specific use case? And, critically, how will that use case drive tangible business impact – whether through cost reduction, risk mitigation, revenue growth, or operational resilience?

Without this clarity, even sophisticated analytics fade into unused tools. With the required clarity, value stream focus follows naturally. Where in the operation does data have the greatest potential to reduce cost, risk, or delay? It might be in batch cycle time, equipment uptime, energy use, or yield consistency. Prioritising these domains ensures that data initiatives are grounded in real, measurable business impact.

Next comes scalability. Pilots and proofs of concept often demonstrate initial value, but fade without a path to global deployment and without proven business value to justify investment. Smart architectures—cloud-enabled, modular, and integrated—allow analytics to be rolled out across lines, plants, and regions without reinvention. This can only be done when the underlying business case is clear and repeatable.

Understanding the role and what data would be needed for decision-makers is crucial to ensure they can consume the data in the right form tailored to their needs. This provides operators with clarity rather than complexity, supervisors with proper trends rather than single transactions, and executives with valuable foresight. All of these are oriented towards solving defined business problems.

Finally, strategies must account for regulatory alignment. In life sciences, medical devices and food, digital systems must support full traceability, electronic batch records, and compliance with global frameworks – such as unique device identification (UDI), the Drug Supply Chain Security Act (DSCSA), and Medical Device Regulation (MDR). Data must not only inform operations, it must withstand audits while delivering measurable business value.



From theory to impact: a real-world transformation case

In Deloitte's work with global manufacturers—especially those in regulated sectors such as life sciences and MedTech—digital transformation at scale consistently delivers a measurable and positive impact.

In one representative case, a multinational manufacturer sought to modernise its fragmented operations, reduce error-prone paper processes, and build real-time visibility across production. The approach began with foundational alignment—standardising manufacturing execution system (MES) and quality management system (QMS) platforms, harmonising data structures, and ensuring traceability across global sites, while fostering proper data governance and ownership in the organisation.

Predictive maintenance capabilities were layered on, leading to notable reductions in unplanned downtime. AI-powered insights into batch release and quality indicators helped identify issues before final testing, improving yield and compliance.

Results seen across comparable projects include:



Significant reduction in manual data entry errors



Increase in throughput and efficiency



Greater audit readiness and speed



Enhanced sustainability through reduced material waste and paper usage.



The human factor

No digital initiative succeeds without the human factor. Data tools change how decisions are made, how teams collaborate, and how performance is evaluated. Without trust, training, and clear communication, even the most powerful platforms can stall.

Successful manufacturers invest in digital fluency at all levels. Operators are empowered with intuitive interfaces and contextual guidance – and given ownership of their data insights and performance outcomes. Supervisors are trained to interpret trends, not just enforce metrics, and to take ownership of team enablement and continuous improvement. Leaders model data-informed decision-making, reward insight-driven behaviours, and demonstrate accountability for digital transformation outcomes.

Change is a capability. Roadmaps must include not only systems integration, but workforce enablement, behaviour modelling, feedback loops and clear ownership structures. These structures define who drives adoption, who supports implementation, and who is accountable for results.

Digital culture is built through trust, transparency, and shared success. When employees see data as a tool for clarity—not control—and understand their role and ownership in the digital journey, adoption accelerates, and impact follows.

Manufacturing reimaged: a future built on data

The future of manufacturing belongs to those who can translate complexity into clarity—who use data not only to understand the present, but to shape the future.

Data is no longer just an operational output. It is an input into resilience. It tells us where to focus, when to act, and how to evolve. When treated as a strategic asset, data becomes the bridge between operational discipline and adaptive agility. Agentic AI agents are now shaping how organisations harness this data – making real-time decisions and continuously adapting strategies without human intervention. These agents enable better performance by translating data complexity into intelligent action at scale.

The next generation of industry leaders will not be defined by how automated their factories are—but by how intelligently they can adapt, orchestrate, and learn. And at the heart of that intelligence will be one constant: data.



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