

# AI and Automation: The Secret to Faster and Safer Pharma Supply Chains

The pharmaceutical industry is under unprecedented pressure. Shorter product lifecycles, increasingly complex therapies, stricter regulatory scrutiny and fragile global supply chains have combined to expose inefficiencies that were once tolerated as “the cost of doing business.” At the same time, patients, regulators and commercial partners expect faster delivery and uncompromising safety.

In this environment, artificial intelligence (AI) and automation are becoming foundational capabilities for building pharmaceutical supply chains that are both resilient and responsive. Nowhere is this more apparent than in secondary packaging and late-stage supply chain operations, areas historically viewed as executional rather than strategic, but which increasingly determine speed to market, compliance outcomes and overall supply continuity.

This article explores how AI and automation are reshaping pharmaceutical supply chains, not as futuristic concepts, but as practical tools already delivering measurable gains in speed, safety and reliability.

## From Bottleneck to Backbone: Reframing Secondary Packaging

Secondary packaging sits at a critical junction in the pharmaceutical value chain. It is the point where drug product, regulatory compliance, supply chain orchestration and patient safety converge. Yet for decades, it has been characterised by labour-intensive processes, fragmented data and heavy reliance on manual decision-making.

Global supply chains, particularly for specialty pharma, biotech and niche branded products, are already long and complex. Any disruption at the packaging stage can cascade downstream, delaying market release or interrupting patient supply. As highlighted in recent industry discussions, shortening fulfilment cycles requires tighter integration between packaging operations and the broader supply chain, rather than treating packaging as a standalone activity.

## Automation has begun to change this dynamic

By removing variability from repetitive tasks such as labelling, serialisation, aggregation and inspection, automated systems improve repeatability and consistency, which are two pillars of GMP compliance. More importantly, they free human expertise to focus on oversight, exception management and continuous improvement rather than manual execution.

## Automation as a Quality Strategy, Not Just an Efficiency Play

In pharmaceutical environments, speed is meaningless without control. One of the most significant contributions of automation is its ability to enhance quality while simultaneously improving throughput.

Automated packaging lines reduce the “human factor” in core processes, not by eliminating people, but by minimising opportunities for manual error in highly repetitive tasks. This is particularly relevant for activities such as serialisation and aggregation, where error rates have direct regulatory and financial consequences. Automation ensures that each pack is treated consistently, every time, regardless of batch size or product complexity.

Crucially, automation also generates structured, high-quality data. Every movement, scan and verification step becomes a data point, creating a detailed digital audit trail. This supports faster batch release, more robust deviation investigations and greater confidence during regulatory inspections.

Rather than viewing automation solely as a productivity tool, leading organisations increasingly treat it as a core component of their quality management strategy.

## Where AI Enters the Equation

While automation standardises execution, AI enhances decision-making. AI systems thrive in data-rich environments, and modern packaging operations generate vast volumes of operational data, from machine performance and line utilisation to material flow and schedule adherence. When applied effectively, AI can analyse these datasets to identify patterns that would be impossible to

detect manually. Current applications of AI in secondary packaging include:

- Production scheduling optimisation, balancing capacity, changeover time and priority orders
- Predictive maintenance, identifying early indicators of equipment failure before downtime occurs
- Risk identification, flagging anomalies that could indicate quality or compliance issues
- Resource allocation, improving labour planning in hybrid automated-manual environments

Rather than replacing human judgment, AI augments it, providing decision support that enables teams to act faster and with greater confidence. As noted in industry briefings, these tools are increasingly embedded not only on the shop floor, but also across cross-company workflows involving customers and material suppliers.

## Exploring the Benefits of AI and Automation in Secondary Packaging

As pharmaceutical supply chains become more complex and time-sensitive, secondary packaging is increasingly recognised as a strategic lever rather than a purely operational function. Advances in AI and automation are accelerating this shift, enabling packaging operations to move faster, operate more safely and integrate more seamlessly with the wider supply chain. From enhanced data visibility to smarter risk management, these technologies are redefining how value is created at the final stages of pharmaceutical production.

### 1. Data Visibility and Trust in the Supply Chain

One of the most transformative yet often overlooked impacts of AI-enabled automation is its role in building trust across the supply chain. For specialty pharma and biotech companies, transparency is essential for managing small batches, fluctuating demand and regulatory complexity.

Digitised packaging environments generate continuous streams of structured data, which can be consolidated and shared through secure platforms. Near real-time

visibility into production status, material availability and batch progress allows supply chain partners to move beyond periodic updates and manual reporting. Instead, stakeholders gain a shared, data-driven view of operations.

This level of transparency reduces friction, limits the need for escalation-driven communication and enables more informed decision-making. Crucially, it also supports deeper collaboration. When packaging partners are digitally embedded into their customers' workflows, they can anticipate requirements, respond faster to change and operate as a true extension of the customer's supply chain rather than as a transactional service provider.

## 2. Enabling Flexibility in a Small-Batch World

The growth of personalised medicines, orphan drugs and advanced therapies has fundamentally altered the economics and expectations of pharmaceutical packaging. Traditional high-volume models are increasingly ill-suited to a landscape defined by smaller batch sizes, frequent changeovers and diverse market-specific requirements.

AI and automation are key enablers of this new operating model. Automated packaging lines designed for rapid reconfiguration can support multiple products and formats without compromising efficiency or quality. At the same time, AI-driven planning and scheduling tools can dynamically adapt to last-minute changes, urgent orders or material constraints, helping to maintain flow in an inherently variable environment.

This flexibility is particularly critical for emerging and mid-sized biopharma companies, which may lack the internal scale or infrastructure to manage such complexity on their own. Packaging partners equipped with intelligent systems are better positioned to absorb variability, manage uncertainty and protect timelines without transferring operational risk back to the client.

## 3. Safety, Compliance and Proactive Risk Management

As regulatory scrutiny intensifies, pharmaceutical companies and their partners are under increasing pressure to demonstrate control, traceability and data integrity across outsourced operations. In this context, AI and automation are becoming central to modern compliance strategies.

AI-driven analytics enable a shift from reactive quality management to proactive

risk mitigation. Machine learning (ML) models can detect subtle deviations in process performance or equipment behaviour long before they result in out-of-specification outcomes or batch failures. Early intervention reduces waste, prevents disruption and, most importantly, safeguards patient safety.

Automation further strengthens compliance by embedding traceability into every stage of the packaging process. Serialisation and aggregation systems ensure that each individual pack can be tracked throughout the supply chain, supporting recalls, anti-counterfeiting measures and regulatory reporting. Together, AI and automation create a more resilient operational framework, one capable of maintaining compliance and continuity even in the face of disruption.

## 4. Smart Packaging: Promise Versus Reality

Smart packaging technologies, including connected packs and dose-tracking systems, are often highlighted as the next major advance in patient safety and adherence monitoring. While their potential is widely acknowledged, real-world adoption in commercial pharmaceutical markets remains limited.

To date, demand for smart packaging has been concentrated largely in clinical trials and highly specialised products. Barriers such as cost, infrastructure complexity and unclear reimbursement models have slowed broader uptake, particularly for established commercial therapies.

However, the relevance of smart packaging should not be dismissed. The digital and data infrastructure being built today through AI-enabled automation provides a critical foundation for future adoption. As technology matures and commercial drivers strengthen, organisations with robust digital capabilities will be best positioned to integrate smart packaging solutions quickly and at scale.

## The Human Factor Still Matters

Despite advances in AI and automation, people remain central to pharmaceutical supply chains. Technology can standardise processes and surface insights, but it cannot replace accountability, judgement or collaboration.

The most successful implementations treat AI as a tool to empower teams, reduce cognitive load, eliminate manual drudgery and enable professionals to focus on higher-value activities. This is particularly important



in environments where trust, responsiveness and partnership are key differentiators.

As niche and specialised service providers regain prominence, their ability to combine technological sophistication with human-centric service models may prove decisive.

## Building the Intelligent Supply Chain

The pharmaceutical supply chains of the future will be defined by how effectively multiple systems work together rather than by a single technology:

- Automation will continue to drive consistency and speed.
- AI will increasingly orchestrate decisions across planning, execution and risk management.
- Data will become the connective tissue linking partners across the value chain.

For organisations willing to invest in technology, integration, data quality and people, the payoff is significant: faster market access, safer products and supply chains that can withstand uncertainty rather than being derailed by it.

In an industry where patient outcomes depend on operational excellence, AI and automation are rapidly becoming the quiet enablers of trust, resilience and performance across the pharmaceutical supply chain.



**Boy  
Tjoa**

Boy Tjoa, as Global Director of Engineering, leads the global engineering function, ensuring that facilities, equipment, and technical standards are optimised to support operational excellence and future growth. He is responsible for engineering performance across sites, including the setup and qualification of new packaging lines in the US facility, while ensuring compliance, reliability, and continuous technical improvement.