

A female scientist with blonde hair in a ponytail, wearing a white lab coat, safety goggles, and a white face mask, is focused on looking through a black microscope. She is wearing white gloves. The background is a blurred laboratory setting with blue lighting. The overall image has a dark blue overlay.

# Intelligent Recipe Authoring & Optimization

Simplify, standardize, and accelerate recipe  
authoring on top of your existing MES

**brillio**

# The pressure, and where it lands

The bottleneck that quietly caps everything downstream of it.

The economics of BioPharma manufacturing are changing. Traditional profit pools are being disrupted, and the operating models that delivered dependable returns for years are no longer enough on their own. The companies that keep growing are the ones evolving toward AI-embedded, data-driven operating models, and treating that shift as the foundation for scale rather than a set of isolated upgrades.

That pressure has to land somewhere concrete, and in BioPharma it lands hard on recipe management. The recipe is where a product becomes real: the steps, parameters, formulas, and equipment context that turn raw materials into a compliant batch. When authoring a recipe is slow, manual, and dependent on a handful of experts, everything else slows with it. New products take longer to launch, sites drift out of alignment, and every change carries compliance risk. Speed up recipe authoring and you speed up the plant. Leave it untouched and it quietly caps everything else.

This is the gap we set out to close.

# What the foundation has to be

Six foundational enablers for accelerating MES transformation at scale

Closing that gap is not a single move. Recipe authoring sits on top of the wider MES estate, so it can only go as fast as the foundation beneath it. Six enablers form that foundation, and together they decide whether transformation actually scales.

**Operator UX and change management.** Persona-based modern interfaces and guided workflows cut training time and lift both adoption and compliance.

**Cloud-native architecture.** Modular, scalable MES deployments lower total cost of ownership, speed up validation, and bring governance under one roof across sites.

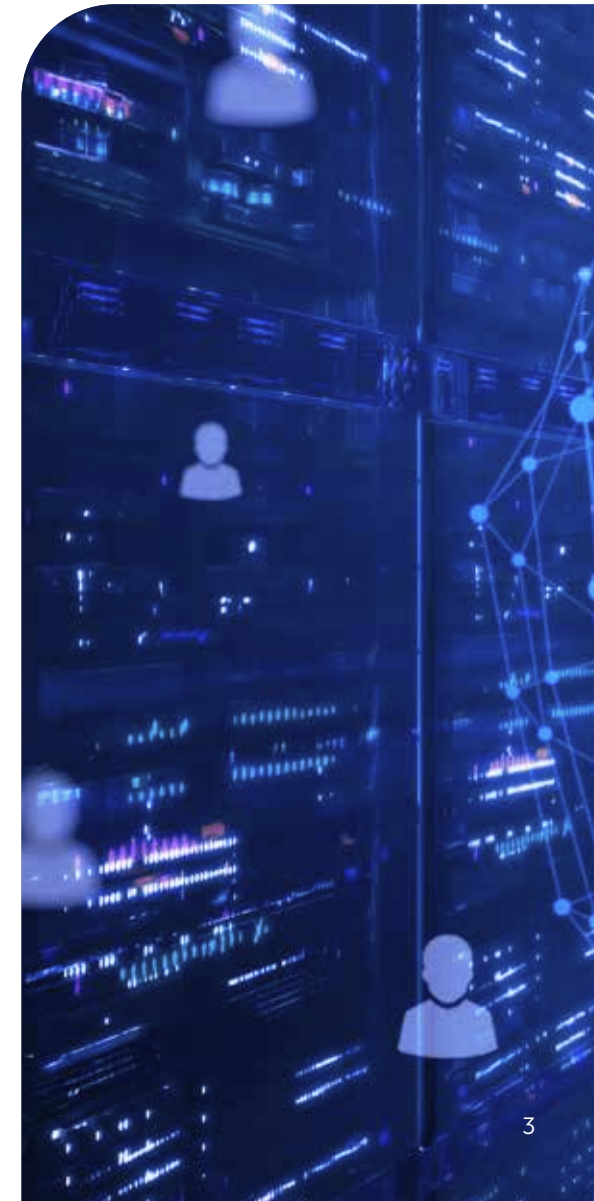
**AI-led innovation.** Predictive quality, smart scheduling, and autonomous deviation detection sharpen decisions and optimize how batches run.

**Cross-system interoperability.** Connecting MES, ERP, LIMS, QMS, and SCADA delivers real-time visibility, unified analytics, and complete batch traceability.

**Embedded compliance and data integrity.** Built-in GxP controls, digital audit trails, and 21 CFR / Annex 11 compliance make a site ready from Day 1 and shorten release cycles.

**Digital twins and plant simulation.** Virtual process models let teams transfer technology faster, optimize recipes, and improve continuously without disrupting production.

The enablers describe the target operating model. The next question is practical: where does a given site sit against it today, and how far is the climb?



# Where you stand today

Five stages from paper-based operations to an AI-driven MES backbone

Most organizations can place themselves on a clear curve. The point is not the label but the direction of travel, and the recognition that recipe management has to move up the curve alongside everything else.

1. **Manual and paper-based.** Paper records, isolated OT systems, manual QA, and poor traceability.
2. **Point automation.** Digitized batch records, local SCADA / PLC automation, and operations that still run in silos.
3. **Integrated MES.** A core MES with electronic batch records, partial ERP / LIMS integration, and standard workflows.
4. **Intelligent MES.** Real-time operations with IoT, predictive analytics, cloud-ready and harmonized data.
5. **AI-driven MES backbone.** Digital twins, AI/ML-driven automation, autonomous decisions, and agentic orchestration.

Wherever a site sits today, the path upward runs straight through recipe authoring. So that is exactly where we focused.

# The answer

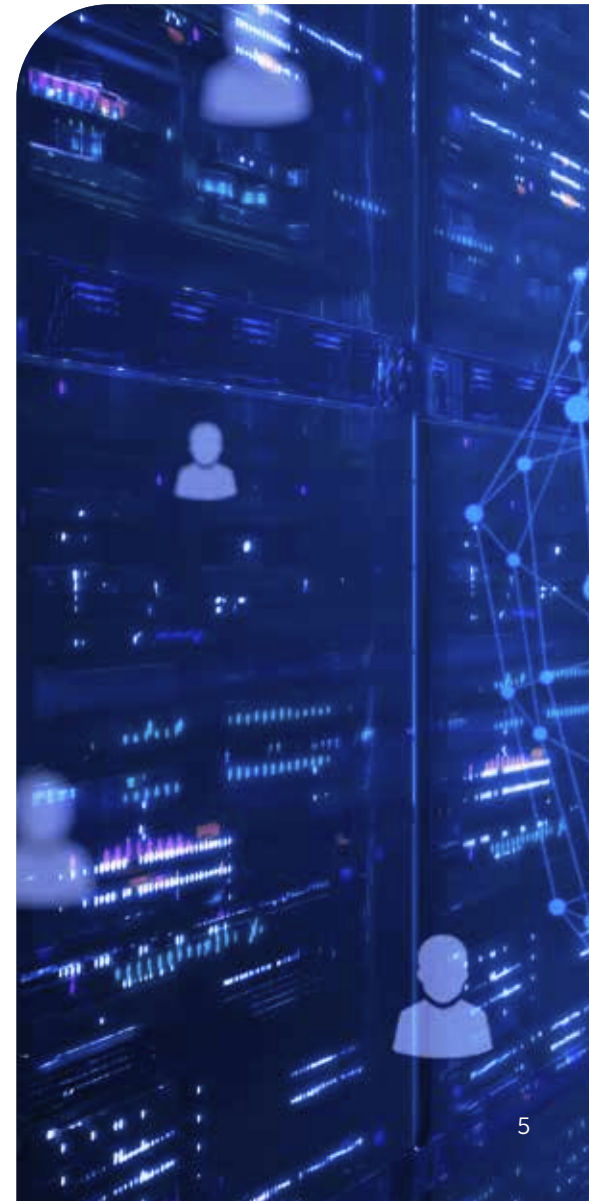
Six capabilities covering the full lifecycle, from first configuration to deployable recipe

We built a streamlined, intuitive solution that sits on top of MES systems and does three things to recipe authoring: simplifies it, standardizes it, and accelerates it. It takes today's complex, error-prone configuration and turns it into something fast and reusable. Along the way, it bridges skill gaps, supports compliance, and makes deployment secure and site-ready.

What holds it together is a single idea: a unified digital thread. Recipe objects, parameters, formulas, master data, and equipment context are defined once and carried consistently across products, recipes, sites, and environments. That thread is what turns standardization and reuse from a goal into a default.

The solution delivers on this through six capabilities that cover the full authoring lifecycle, from the first configuration to a validated, deployable recipe.

- **Intuitive recipe authoring.** Configure recipe objects, formulas, and paths inside the MES, with drag-and-drop support and guided input that make authoring approachable rather than expert-only.



- **Reusable configuration components.** Define recipe objects, parameters, and formulas once, then apply them across products, recipes, and sites to enforce standardization.
- **Rich metadata management.** Customize master data for header definitions and cross-referencing, configure equipment areas, classes, and properties with import and export, and fully contextualize recipe execution.
- **Parameter management with built-in controls.** Input, display, and output parameters carry their own validation logic, default values, and naming conventions, support multiple data types, and keep configuration logic clean and consistent.
- **Import and export across environments.** Move recipe objects and recipes cleanly across dev, test, and prod, automate version transport and environment sync, and minimize configuration drift.
- **Simulation and validation engine.** Simulate recipe behavior in a lower environment before the production push, reconfigure instantly from test outputs, and support iterative development that takes errors out of deployment.

Those capabilities are not abstract. Here is how they come together in practice.



# How it works

How the interface, backend, and data store connect to the existing MES

The solution runs as a new application alongside the existing MES, on premises, so it extends what a site already has rather than replacing it. A React JS interface gives authors and developers a modern, guided experience. A Node-based backend layer and a dedicated data store handle configuration and persistence. The application reads from and writes to the MES through web services, reads MES data via SQL, and stays aligned with the MES through a configuration data sync.

Two roles do the work, and the design gives each a clear lane.

**The recipe author** defines test data to validate recipe objects, tests and simulates the configuration, and publishes a finished recipe data set.

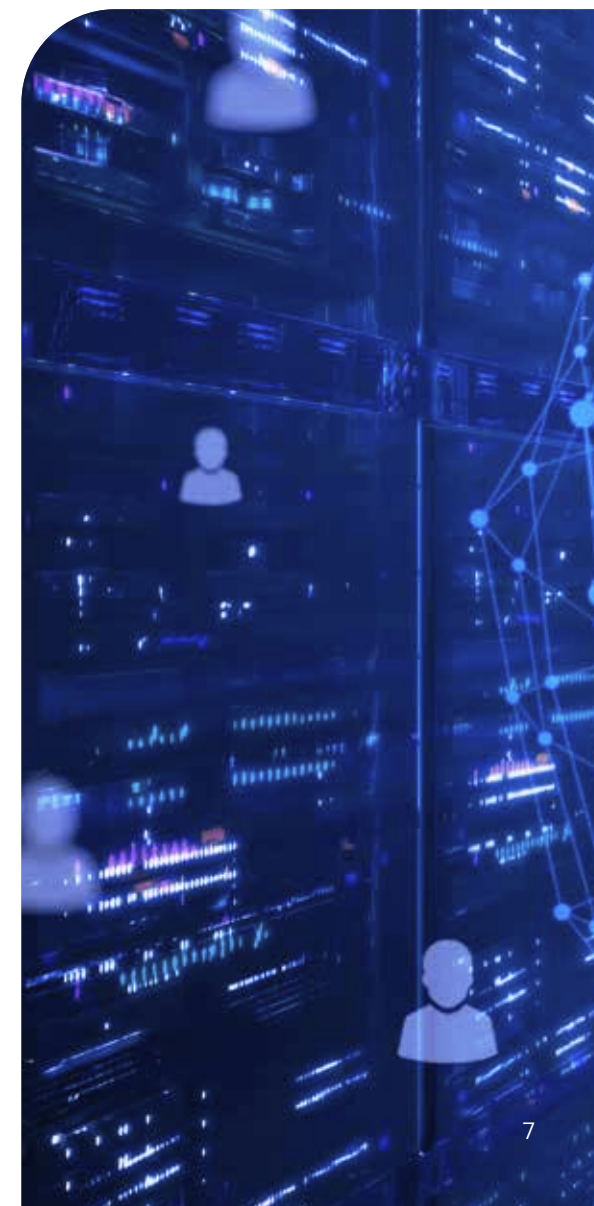
**The recipe developer** adds the recipe base objects, configures an operation's data model, and describes the steps while adding metadata for recipe objects.

Behind the interface, the application is organized into the building blocks of a recipe, and each one supports import and export so configuration moves cleanly between environments.

Recipe objects hold input, output, and display parameters. Recipes bring together step configuration, formula configuration, recipe paths, flowcharts, and simulation. Master data defines the customizable headers used in parameter configuration.

Equipment data captures equipment areas, classes, and properties. Underneath them all, the backend layer connects the interface to the data store, and the configuration data sync keeps the MES store and the application aligned.

The result is a clean separation between authoring and the live MES, with controlled, traceable movement of configuration in between.



# One level down

## The technical depth behind the authoring experience

The building blocks describe what the application contains. One level down is the configuration model, where authoring gets its precision.

A recipe object carries more than its parameters. It also holds iteration configuration, categories, and version history, so an object can evolve over time without losing its lineage. Within it, three parameter types do the work:

Input parameters come in several types (integer, float, string, master data, and enumerations), each with its own validations and default values.

- **Display parameters** are configured with rich text editors and table structures.
- **Output parameters** carry descriptions and display names.

Recipes then apply those parameters through a few precise mechanisms:

- **Step configuration** sets the input, display, and output parameters for each configured iteration.
- **Formula configuration** applies recipe formulas to steps and to input or output parameters.

Recipe paths are defined as a sequence of steps and transitions.

Define once at this level, and the same objects, parameters, and formulas carry across products, recipes, and sites. That reuse is where the business value begins.

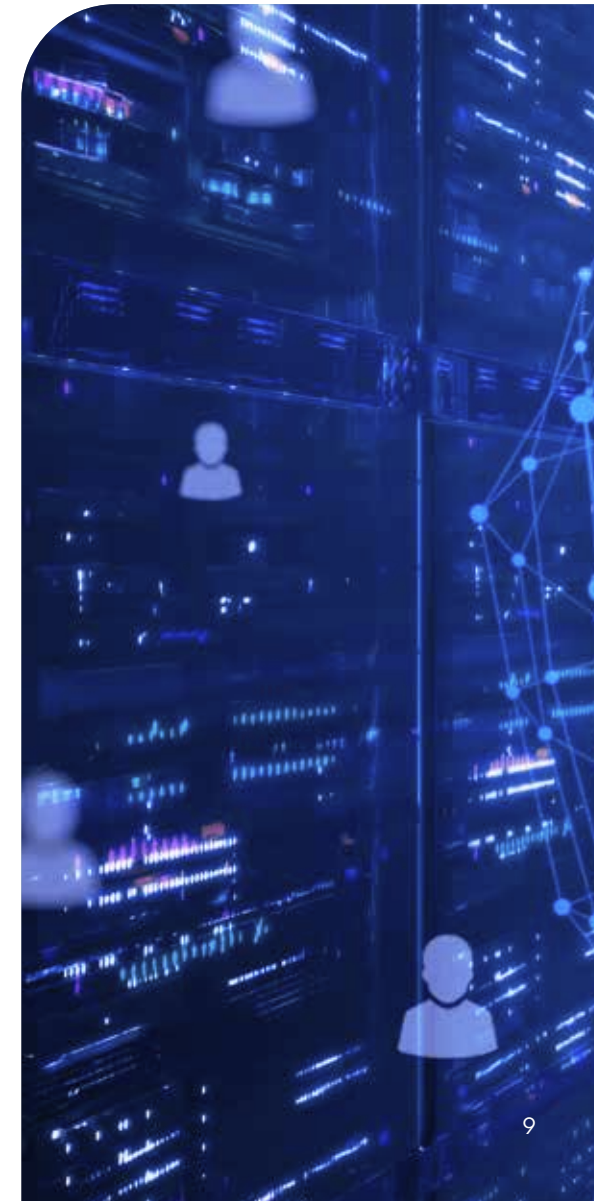
# What it changes

The outcomes a site can measure and feel

This is where it pays off. The whole solution exists to drive speed, standardization, and operational excellence in recipe management, and the unified digital thread for manufacturing turns that intent into outcomes a site can measure and feel.

- Faster recipe development. A 30 to 50% reduction in time-to-deploy.
- Standardization and reuse. Less duplication, and global consistency that holds.
- Improved site agility. The freedom to adapt to product and process changes without friction.
- Reduced skill dependency. A shorter ramp-up for junior recipe authors. Zero-error configs. On-screen error handling and simulation that catch problems before they reach production.

Taken together, recipe authoring stops being a bottleneck owned by a handful of experts and becomes a fast, standardized, and compliant process that scales across products, recipes, and sites. That is the shift the opening called for, made real.



## ABOUT BRILLIO

Brillio is The Enterprise AI Accelerator helping Fortune 1000 companies move from AI ambition to scaled impact, faster. Powered by our AI accelerator platform – Agentic Data and Application Management (ADAM), Brillio is one of the fastest-growing digital technology service providers, delivering transformation across five core workstreams: business-led transformation, customer experience transformation, AI and data engineering, digital engineering, and infrastructure engineering.

With 14 delivery locations across North America, Europe, and Asia and a team of over 6,000 customer-obsessed professionals, Brillio combines deep industry expertise, modern engineering, and accelerators to deliver measurable outcomes. Headquartered in Dallas, Texas, Brillio serves clients globally with a commitment to speed, scale, and measurable impact.



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