mosaic
by Cenevo

Machine Fulfilment Application Note
Mosaic Machine Fulfilment (MF)

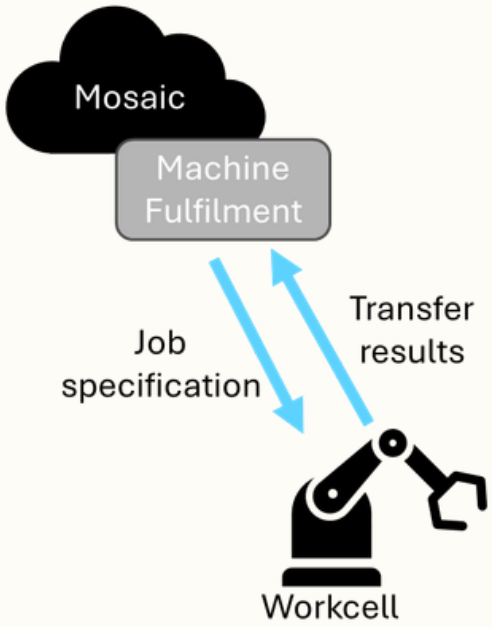
INTRODUCTION

Modern laboratories increasingly rely on automated liquid handling platforms and integrated workcells to deliver throughput, accuracy, and reproducibility. While automation hardware has advanced rapidly, the software layer responsible for orchestration, traceability, and data integrity often lags behind, resulting in fragmented user experiences and bespoke integrations.

Mosaic Machine Fulfilment (MF) addresses this challenge by providing a unified, future-ready fulfilment module within Mosaic. MF enables Mosaic orders to be fulfilled through a wide range of automated liquid handling platforms using a consistent web-based user experience and a robust, vendor-agnostic integration model. It is designed to replace and unify earlier Mosaic fulfilment approaches, while laying the foundation for long-term scalability and vendor collaboration.

What is Machine Fulfilment?

Machine Fulfilment is a Mosaic module that enables the execution of Mosaic orders on automated liquid handling machines and workcells. From an operator's perspective, the MF web UI allows users to select one or more Mosaic orders, and any subset of their workflow steps and input labware items to be prepared into machine job for fulfilment. Thereafter, operators can monitor progress and results in real time. From an integration perspective, MF exposes a REST API through which automation platforms retrieve job specifications and report back transfer results and events.



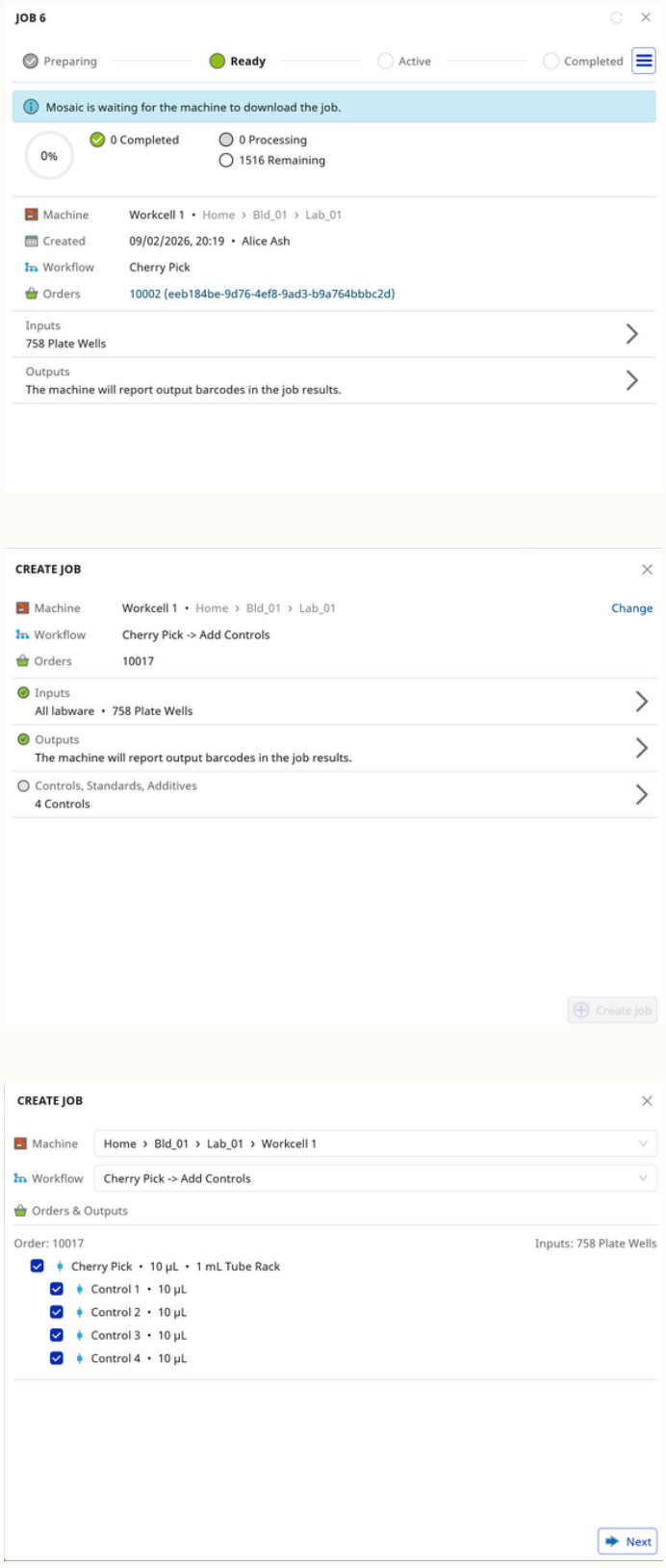
MF is intentionally positioned as a **high-level fulfilment application**. Rather than encoding machine-specific logic in Mosaic, MF focuses on defining what needs to be done, leaving how it is executed to the machine driver or scheduler. This separation simplifies Mosaic configuration, improves portability across vendors, and enables consistent behaviour across diverse automation environments.

Typical Usage Flow

A typical Machine Fulfilment workflow follows a clear and intuitive sequence:

1. A user creates and submits an order in Mosaic using standard ordering workflows
2. From the Mosaic web UI, the user selects one or more orders and chooses Create Machine Job
3. The user selects a machine, workflow fragment, which source sample labware to fulfil, and provides any required inputs such as source labware for controls, or standards
4. Machine Fulfilment generates a structured job specification describing the required transfers and operations
5. The automation platform retrieves the job specification via the MF REST API and executes the physical work
6. As transfers are completed, the platform reports results and notifications back to Mosaic
7. Mosaic updates inventory, workflows, and audit trails based on the reported outcomes.

This model supports jobs spanning multiple orders or operations and provides a clear lifecycle for monitoring, retrying, cancelling, or abandoning jobs when required.



Machine Fulfilment delivers a broad set of capabilities that reflect real-world automation needs

Unified fulfilment experience
MF consolidates functionality that previously existed across multiple Mosaic fulfilment applications into a single, coherent module. This reduces operational complexity and provides a consistent experience regardless of the underlying machine or vendor.

Web-based user interface
All MF interactions are delivered through Mosaic web pages. Operators can create, view, and manage jobs without installing desktop applications, enabling access from anywhere with appropriate permissions.

Support for multi-step workflows
MF supports complex, multi-operation workflows such as cherry picking followed by serialisation and replication. Workflow fragments allow users to control how much of an order is processed within a given machine job.

Standards, controls, and mixtures
MF supports workflows that include standards and controls, offering flexibility in how they are dispensed. MF supports the fulfilment of Mosaic's mixture creation workflows, with full tracking of constituents transferred throughout, to ensure accurate inventory updates and traceability across all derived samples.

Robust job lifecycle management
Jobs progress through clear states and can be monitored, retried, cancelled, or abandoned as needed. Errors reported by machines are captured and surfaced in Mosaic, ensuring issues can be diagnosed and resolved without losing data integrity.

User Experience

A central design goal of Machine Fulfilment is to improve usability for both operators and automation specialists. MF is tightly integrated with existing Mosaic ordering and workflow pages, reducing context switching and training overhead.

Operators interact with familiar Mosaic concepts—orders, operations, labware, and workflows—rather than machine-specific abstractions. Job creation is guided and constrained by configuration, reducing the risk of invalid or incompatible setups. Once a job is running, users can track progress and outcomes directly in Mosaic, without needing to access vendor-specific software.

This approach supports both occasional users and high-throughput environments, while maintaining a consistent audit trail and clear ownership of actions.

Support for multi-step workflows
MF supports complex, multi-operation workflows such as cherry picking followed by serialisation and replication. Workflow fragments allow users to control how much of an order is processed within a given machine job.

Standards, controls, and mixtures
MF supports workflows that include standards and controls, offering flexibility in how they are dispensed. MF supports the fulfilment of Mosaic's mixture creation workflows, with full tracking of constituents transferred throughout, to ensure accurate inventory updates and traceability across all derived samples.

Robust job lifecycle management
Jobs progress through clear states and can be monitored, retried, cancelled, or abandoned as needed. Errors reported by machines are captured and surfaced in Mosaic, ensuring issues can be diagnosed and resolved without losing data integrity.

User Experience

A central design goal of Machine Fulfilment is to improve usability for both operators and automation specialists. MF is tightly integrated with existing Mosaic ordering and workflow pages, reducing context switching and training overhead.

Operators interact with familiar Mosaic concepts—orders, operations, labware, and workflows—rather than machine-specific abstractions. Job creation is guided and constrained by configuration, reducing the risk of invalid or incompatible setups. Once a job is running, users can track progress and outcomes directly in Mosaic, without needing to access vendor-specific software.

This approach supports both occasional users and high-throughput environments, while maintaining a consistent audit trail and clear ownership of actions.

Integration Model and Vendor Support

Machine Fulfilment is built around an open and extensible integration model. At its core is the **Machine Fulfilment REST API**, which defines how job specifications are retrieved and how execution results are reported back to Mosaic.

Key characteristics of the integration approach include:

- **Vendor-agnostic design:** MF does not assume a specific scheduler, robot, or pipetting technology.
- Driver-based integrations: A machine driver translates Mosaic job specifications into the native instructions required by a specific platform.
- Flexible ownership: Drivers can be developed by Titian, customers, automation vendors, or third-party integrators.
- Future-ready architecture: The API-based approach supports both direct online integrations and file-based or hybrid models where required.

Machine Fulfilment is already being used with a range of advanced fulfilment platforms and schedulers, including:

- **Biosero** Green Button Go
- **HighRes** Cellario OS
- **Tecan (Wako Automation)** Director
- **Thermo Fisher Scientific** Momentum

Cenevo is continuing to work with other automation partners to expand the ecosystem of supported machines and workflows.

Deployment and Scalability

MF is designed to scale with both laboratory size and organisational complexity. A single Mosaic instance can be configured with one or more machines, and MF can operate across different Mosaic deployment models, including customer-hosted and cloud-hosted environments.

By separating fulfilment logic from machine execution, MF simplifies upgrades and enables new machine integrations without requiring disruptive changes to Mosaic core workflows.

Summary

Mosaic Machine Fulfilment represents a significant evolution in how Mosaic integrates with lab automation. By unifying fulfilment functionality, delivering a modern web-based user experience, and providing a robust, vendor-neutral integration model, MF enables laboratories to automate with confidence while preserving flexibility for the future.

As automation strategies continue to evolve, Machine Fulfilment provides a strong foundation for connected labs, scalable integrations, and consistent fulfilment across an ever-expanding ecosystem of machines and vendors.