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FACTORY AUTOMATION

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White paper

MARGIN-PROTECTING PACKAGING MACHINES

An Execution Guide: 4 Digitalization Packages to Stop Margin Leakage

How to reduce engineering effort, protect performance at speed, and reduce service cost - without turning every project into a custom integration exercise.

Industry Thought Leadership

Introduction

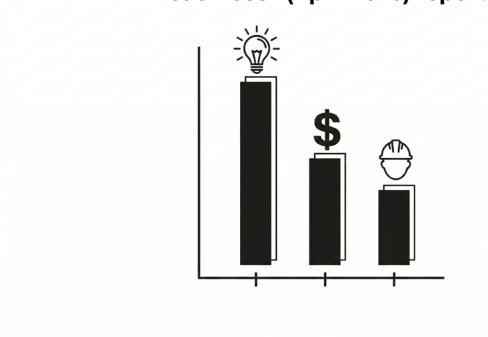
Stop Building Prototypes. Start Building a Platform.

Success in machine building isn't just about delivering a working packaging machine. It's about delivering a solution engineered for a Food & Beverage manufacturer's specific needs - a solution resistant to initial performance dips, one that meets their precise requirements today and adapts to new challenges tomorrow.

The definition of "machine readiness" has shifted. Your customers are no longer looking for hardware that simply passes a Factory Acceptance Test (FAT). They are demanding systems that guarantee Vertical Startup - immediate production stability without the weeks of ramp-up and tweaking that kill ROI.

The Market Reality: Why Your Customers Are Demanding More

The pressure on F&B manufacturers is unprecedented, and it flows directly down to their machine requirements. According to the PMMI "2025 Performance Optimization: Insights for Packaging Line Readiness" (April 2025) report:



- **78%** of packaging industry participants - primarily F&B manufacturers - cite productivity as their top priority.
- **47%** must aggressively control costs across their operations.
- **34%** struggle with severe skilled workforce shortages, forcing them to rely on equipment suppliers for technical expertise.

The Operational Gap

We have deeply analyzed the current challenges facing Food & Beverage manufacturers.
This insight reveals exactly where traditional packaging machines are failing to meet new priorities:

- **The "High-Mix" Pressure:** SKU proliferation is forcing shorter production runs. Manufacturers need machines capable of fast, tool-less changeovers to maintain OEE. If a format switch takes hours of tuning to return to stable speed, the machine becomes a liability.
- **The Skills Gap:** With high turnover among operators, complex manual adjustments are no longer viable. End users need machines with digital recipes and guided recovery that allow less-experienced staff to maintain performance standards.
- **Zero Tolerance for Downtime:** In a cost-constrained environment, "initial performance dips" after installation are unacceptable. Manufacturers expect predictable reliability from Day 1.

The Builder Dilemma: Customization vs. Margin

For Machine Builders, responding to these escalating demands often follows a familiar pattern: Custom Engineering.

Additional sensors are added to address stability issues. Custom code is written to connect to each customer's specific MES (Manufacturing Execution System). Best engineers are dispatched to debug intermittent faults on-site. The result? A great machine is delivered, but engineering hours skyrocket, commissioning schedules slip, and project margins evaporate.

This is the trap of building prototypes.

To survive and profit in this environment, a strategic shift is needed. Digital transformation for machine builders is not about "adding software." It is about building a repeatable digital platform across your machine family.

It is the only way to deliver the flexibility, connectivity, and stability customers demand - without turning every order into a custom integration project.

The Builder Reality: Where Margin is Leaking Today

Margins aren't lost in the Bill of Materials. They are lost in the invisible inefficiencies of engineering and deployment. If protecting project profitability is a challenge, these five common leak points are worth examining:

1. **Interfaces Cause Schedule Slip:**

Motion sync, network timing, safety interlocks, and robotics integration often consume schedule buffers.

2. **"Works at Low Speed" Syndrome:**

Machines pass FAT at 50% speed but fail under load, requiring late-stage fixes that raise BOM (Bill of Materials) costs.

3. **Changeovers are Under-Engineered:**

Parameter chaos leads to scrap spikes and downtime after every format switch.

4. **Service Doesn't Scale:**

Complex troubleshooting relies on a few key experts, draining your top engineering talent.

5. **Customer Connectivity Becomes Custom Work:**

Every end user requests data differently, turning projects into integration jobs.

Your Margin Protection Strategy: 4 Digitalization Packages

To plug these leaks and meet customer demands without eroding profits, we have defined four specific Digitalization Packages.

These are not abstract concepts. They are concrete sets of capabilities, supported by proven Mitsubishi Electric technologies and validated by real-world implementations in packaging machines. Each package addresses a specific area where margin is lost and value is created.

PACKAGE 1: DATA-READY BY DEFAULT

Goal: Eliminate Integration Effort & Accelerate Commissioning

Margin Leak Detector

Your Perspective: Projects often turn into custom IT integration jobs. Engineers spend days mapping memory addresses instead of optimizing machine performance.

Client Perspective: They are under pressure to deliver data to MES/ERP systems. When machines arrive without a standardized interface, their IT teams struggle to extract meaningful data, delaying production start-up.

The Strategic Shift: From Custom Code to Productized Interface

A growing number of successful machine builders are shifting from reacting to every unique data request to defining a robust standard.

- Define a "Golden Dataset": Rather than asking "what do you need?", consider delivering a standardized block of tags (State, Mode, Counts, Alarms, OEE) that exists in every machine shipped. This approach allows customers to adapt to a proven standard, rather than requiring custom development for each deployment.
- Decouple IT from OT: Using a dedicated communication channel (such as OPC UA) ensures that IT queries don't interfere with the machine's internal control logic, protecting production cycle time.

The Enabler: Built-in OPC UA Server

The MX and FX5 series PLCs feature built-in OPC UA servers. This allows a "Golden Dataset" to be exposed securely and structurally without external gateways or complex PC-based middleware.

Seamless Integration: Real-World Proof

When machines are designed for streamlined data exchange from the start, meeting strict traceability and MES requirements doesn't have to delay commissioning or hinder operational efficiency.

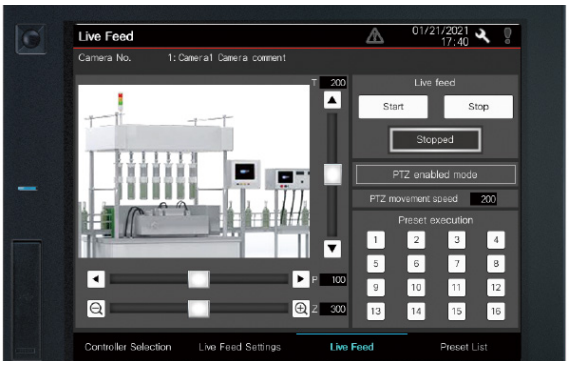
The Challenge: A customer required a semi-automatic system to pack diverse cheese formats (slices, portions, wedges, sachets, blocks) into cartons. Key goals were increasing throughput and significantly reducing labor dependency while ensuring integration with production systems.

The Solution: The machine builder implemented a system with programmable chambers to handle variable stack quantities and standardized data integration.

The Results:

- Throughput: Increased to 140 packages per minute.
- Labor: Reduced staffing needs by 40-70% on the packaging line.
- ROI: Approximately 1 year payback time for the end user.

PACKAGE 2: SERVICE ABILITY IS A FEATURE



Goal: Reduce MTTR & First-Time-Fix Rate

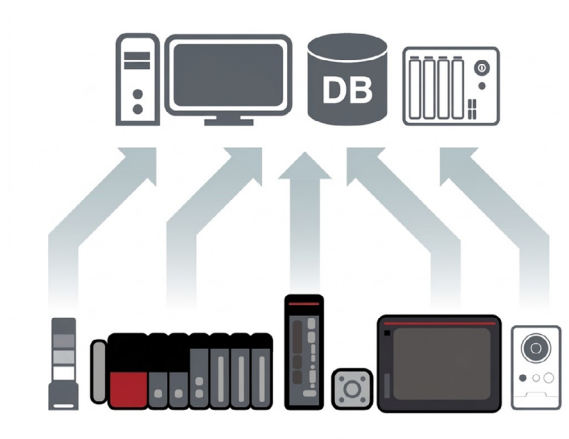
Margin Leak Detector

Your Perspective: Intermittent faults are among the most challenging service issues. Sending a technician to a site to wait for an error to occur is financially unsustainable.

Client Perspective: They face a critical shortage of skilled operators. When a machine stops, they often lack the internal expertise to diagnose the root cause, leading to prolonged outages while waiting for machine provider support.

The Strategic Shift: From "Monitoring" to "Evidence Capture"

Leading machine builders are moving beyond simple remote access (which only shows current status) to "flight-recorder" capability. The goal is to shift the service model from "travel to diagnose" to "diagnose then fix".



- Implement "Black Box" Recording: Don't just log the error code. Record the logic states of all inputs and outputs before, during, and after an error occurs. This provides a complete "flight record" of the event, allowing you to see the exact sequence that led to the fault, the fault itself, and the machine's reaction.
- Prescriptive Alarms: Rewriting alarm logic to guide the operator can significantly reduce support calls. For example, instead of "Error 404: Servo Fault," an alarm might read "Jam at Infeed A. Check sensor alignment." This empowers operators to resolve issues without immediate intervention.

The Enabler: System Recorder

The System Recorder module for MX Controller series creates a deterministic record of all PLC execution before and after an event trigger. This allows engineers to "play back" the failure remotely, identifying the root cause without needing to be on-site.

Risk Elimination: Real-World Proof

When complexity increases, the risk of downtime multiplies. This case study demonstrates how a modular approach to automation architecture protects uptime in complex, multi-station systems.

The Challenge: An end user needed to depalletize and pack cheese blocks. The complexity lay in coordinating two independent Cartesian robot stations to handle four different formats simultaneously. Managing this multi-station interplay created a significant risk of downtime and integration errors.

The Solution: The machine builder deployed a synchronized multi-robot architecture. By designing the system as independent yet coordinated modules, they ensured that a fault in one station wouldn't cascade, maintaining high availability.

The Results:

- **Capacity:** Achieved 25 blocks per minute per station, doubling previous capacity.
- **Efficiency:** Successfully automated the handling of 4 different product formats.
- **ROI:** Customer's Investment return achieved in under 2 years thanks to consistent uptime.

PACKAGE 3: DETERMINISTIC PERFORMANCE AT SPEED

Goal: Stable Performance & Predictive Quality

Margin Leak Detector

Your Perspective: Machines often run perfectly during slow tests but develop timing issues or instability at full production speed. Adding sensors late in the process increases BOM cost without always addressing the root cause.

Client Perspective: They need consistent output, not just burst speed. Micro-stoppages and speed losses due to mechanical wear directly impact their ability to meet retail orders.

The Strategic Shift: From External Sensors to Component Intelligence

Rather than adding complexity with external sensors, forward-thinking machine builders are leveraging the intelligence already built into modern automation components.

- Leverage Drive-Based Analytics: Modern servos, like J5, monitor their own friction torque, load characteristics, and vibration patterns. These internal signals can be mapped to simple "Traffic Light" indicators on the HMI, providing early warning of mechanical wear.
- Position "Self-Monitoring" as a Feature: This capability can be marketed to customers as a way to reduce their maintenance costs and improve uptime predictability. It justifies a premium price point while reducing warranty risk.

The Enabler: Servo & Inverter Diagnostics

MR-J5 Servos and FR-A800 Inverters feature built-in predictive maintenance algorithms. They monitor mechanical health indicators internally, providing early warnings without additional hardware cost or complexity.

High-Speed Stability: Real-World Proof

High speed combined with heavy payloads creates physics challenges that threaten reliability. This example proves that robust, deterministic control is the key to maintaining throughput without mechanical failure.

The Challenge: A project required packing beverage cans into trays (6 or 12 packs) at high speed. The physics of moving heavy payloads using SCARA robots with complex dual-zone grippers creates mechanical stress that often limits operating speed or reliability

The Solution: A project involved packing beverage cans into cardboard trays (configurations of 6 or 12). The solution required a SCARA robot equipped with a specialized dual-zone gripper to handle the load at high speed.

The Results:

- **High Speed:** Throughput of 180 cans per minute (15 trays/min) achieved reliably.
- **Flexibility:** Seamless handling of both 6-pack and 12-pack configurations.
- **Reliability:** Eliminated bottlenecks associated with manual packing of heavy multipacks.

PACKAGE 4: ARCHITECTURE REUSE

Goal: Reduce Engineering Effort & Schedule Slip

Margin Leak Detector

Your Perspective: Integrating separate controllers for Logic, Motion, and Robotics creates complexity. Synchronizing handshakes between a PLC and a separate Robot Controller consumes valuable engineering hours and is a common source of timing errors.

Client Perspective: They want a unified system that is easy to maintain, not a "black box" integration that requires specialist knowledge for every component.

The Strategic Shift: From Silos to a Unified Platform

Progressive machine builders are moving away from treating Robotics, Motion, and Logic as separate engineering disciplines with separate controllers.

- Consolidate Control: Moving to a platform where the PLC CPU can directly control robots and servos eliminates the need for complex handshake logic and reduces latency.
- One Network for All: Using a single high-speed network (such as TSN) for all machine communication simplifies wiring, reduces commissioning time, and ensures deterministic timing across the entire machine.

The Enabler: iQ Platform & CC-Link IE TSN

The iQ-R Platform allows robot control to be integrated directly alongside PLC and Motion control on the same backplane. Combined with CC-Link IE TSN, this ensures deterministic timing across the entire machine without complex gateways or synchronization code.

Synchronized Complexity: Real-World Proof

Integrating multiple complex sequences - from carton forming to final sealing - requires a cohesive control strategy to maintain both high flexibility and aggressive throughput without extending engineering time.

The Challenge: The objective was to build a complete line for packing products into wrap-around cartons (tray + lid). The main challenge was achieving high throughput while maintaining the flexibility to handle single or double-row forming configurations.

The Solution: The machine builder implemented a fully automated station including carton forming, product collation (sumator), and lid application within a unified control architecture.

The Results:

- **Throughput:** 100 cartons per minute achieved.
- **Integration:** The comprehensive line combined forming, packing, and sealing in a synchronized flow.
- **Adaptability:** The architecture supported both single and double-row configurations with minimized changeover friction.

The 5 Measurable Outcomes That Matter

Rather than measuring "digitalization" in abstract terms, focus on these business-critical KPIs to track progress:

1. Commissioning Variance Down:

Focus on making startup timelines predictable to protect project margins - not just reducing average time, but improving consistency.

2. Stable Performance at Production Speed:

Measure hours of uninterrupted stability at 100% speed, not just minutes at low speed during FAT.

3. Changeover Time and Scrap Down:

Track the time from "last good part" to "first good part" of the new format.

4. MTTR Down + First-Time-Fix Up:

Improve service scalability by diagnosing root causes remotely before technicians travel.

5. Customer Integration Effort Down:

Deliver data-ready machines with a standard dataset that plugs into MES in hours, not weeks.

Digital Readiness Checklist

Assessing Your Platform Maturity

Use this checklist to evaluate current capabilities. Each checked box represents a tangible step toward protecting margins and increasing competitive advantage.

Data-Ready by Default

- [ ] A "Minimum Viable Dataset" (MVD) is defined for all machines
- [ ] OPC UA is the standard interface (no custom drivers required)
- [ ] MES connectivity can be demonstrated during the proposal phase

Serviceability is a Feature

- [ ] Logic states can be captured (playback) for intermittent faults remotely
- [ ] HMI alarms provide prescriptive guidance, not just error codes
- [ ] Secure remote access is available without relying solely on customer VPNs

Performance at Speed

- [ ] Drive-based analytics (friction/vibration) are utilized to monitor mechanical health
- [ ] Component health status is displayed on the HMI (Traffic Light system)
- [ ] Motion synchronization relies on deterministic networks, not standard Ethernet

Architecture Reuse

- [ ] Logic, Motion, and Robotics are controlled from a unified platform
- [ ] Network architecture is simplified using a single standard (e.g., TSN)
- [ ] Format changes are managed via software recipes (no code changes)

Interpreting Your Score:

- **10-12 Checks:** Platform is robust, scalable, and margin-protected. Ready to offer advanced service models.
- **6-9 Checks:** Good foundations exist, but occasional integration delays or service inefficiencies may occur. Focus on closing gaps in Serviceability.
- **0-5 Checks:** Margins are at risk. Every project likely feels like a prototype. Consider starting by standardizing the Data Layer (Package 1).

Are you ready to fix the leaks?

Building a repeatable digital platform is a journey, not a destination

It begins with selecting one area where margin is leaking most visibly and implementing the corresponding Digitalization Package

Ready to assess your current architecture?

Want to check one of the digitization packages or want to create it by yourself?

To discuss your specific challenges and opportunities:

Contact Us

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