# Orchestrix – Batching Plant Module

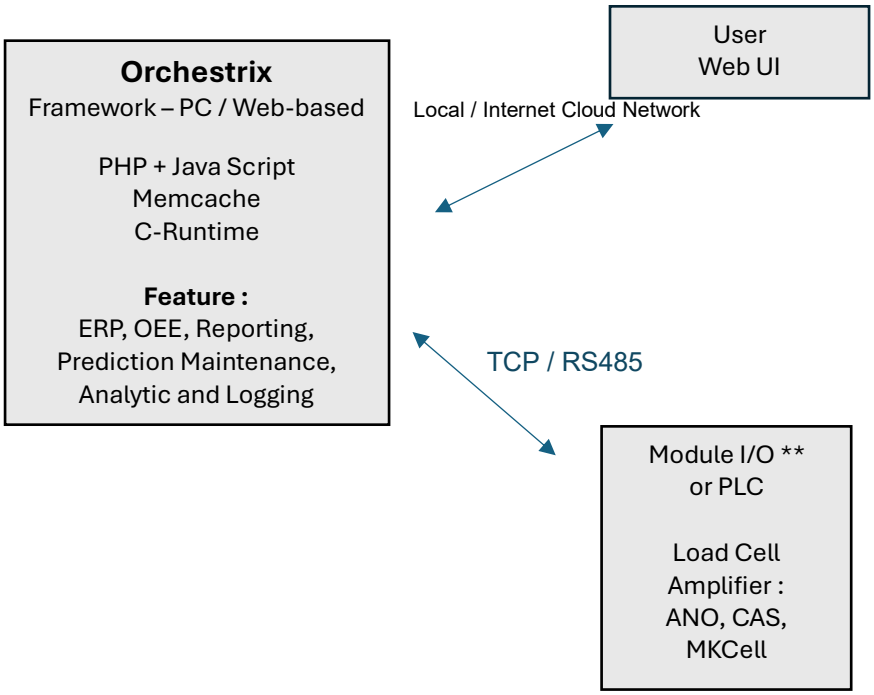
## Overview

The **Orchestrix Batching Plant Module** is part of a lightweight industrial orchestration framework designed for real-time batching automation, ERP integration, OEE data collection, predictive maintenance, and centralized monitoring.

It connects directly to PLCs and load-cell amplifiers without requiring external bridges, making it extremely fast, reliable, and brand-agnostic

## System Architecture

***Comparison with existing batching plant Architecture on the last page**



### Frontend

- Web-based UI (JavaScript)

### Backend

- PHP
- Custom C/C++ runtime modules
- Memcache (queue + caching layer)
- MySQL database

### PLC Communications

Supports multiple industrial PLC brands:

- Mitsubishi Dedicated Protocol (reverse-engineered engineering protocol)
- Omron Protocol
- Schneider / Modbus
- Modbus TCP

### Deployment

- FTP deployment via **WinSCP** (legacy industrial environment)

# Batching Plant Features

### Core Features

- ERP → Automatic batching job creation
- Real-time ingredient weighing
- Automatic sequence control (mixing, dosing, loading)
- Load cell amplifier integration
- Remote I/O & PLC command execution
- Real-time runtime logging
- Event monitoring + alarms
- Full traceability (batch history)

### Operational Features

- Multi-plant centralized web control
- 1 operator can run multiple batching lines
- Remote troubleshooting & maintenance
- **Brand-agnostic** hardware support
- Very lightweight (no middleware bridge needed)

# Performance & Impact

***2+ years continuous operation*** *in real industrial environment*

| Feature | Before Orchestrix | After Orchestrix | Benefit |
|---|---|---|---|
| Management Visibility | Depends on operator reports | **Real-time live monitoring from anywhere** | Full transparency |
| Production Tracking | Manual logs, inconsistent | **Automatic recording of every batch** | Zero missing data |
| Process Monitoring | No visibility into running processes | **Live status of all active processes & jobs** | Faster decision-making |
| Material Usage Tracking | Hard to detect loss or unrecorded use | **Exact material tracking with timestamps** | Prevent material shrinkage |
| Operator Actions | Cannot verify actual activity | **Every action time-stamped & auditable** | Accountability |
| Real-Time Audit | Only possible after shift ends | **Owner/management can audit anytime** | Immediate oversight |
| Quality Retrace / Traceability | Difficult or impossible | **Complete batch history & quality retrace** | Easier root-cause analysis |
| Operator Capacity | 1 operator per plant | **1 operator can handle multiple batching plants** | Lower labor cost |
| Predictive Maintenance | Reactive, downtime unpredictable | **Predictive alerts based on machine data** | Reduced downtime |
| Remote Troubleshooting | Must be on site | **Remote diagnostics & troubleshooting** | Faster recovery, lower cost |

## Data Intelligence & Analytics

Orchestrix generates:

- Material accuracy variance
- Cycle time distribution
- Batch quality metrics
- Equipment error patterns
- Predictive failure alerts
- Production volume summaries
- Capable of weighing operations without job order
- Minimizes material corruption and theft
- Provides deep analysis and historical quality records for batching plant performance

## PLC Edge Integration

Orchestrix communicates directly with:

- Mitsubishi PLCs
- Omron PLCs
- Schneider PLCs (Modbus)
- Modbus TCP devices
- Load cell amplifiers

This allows:

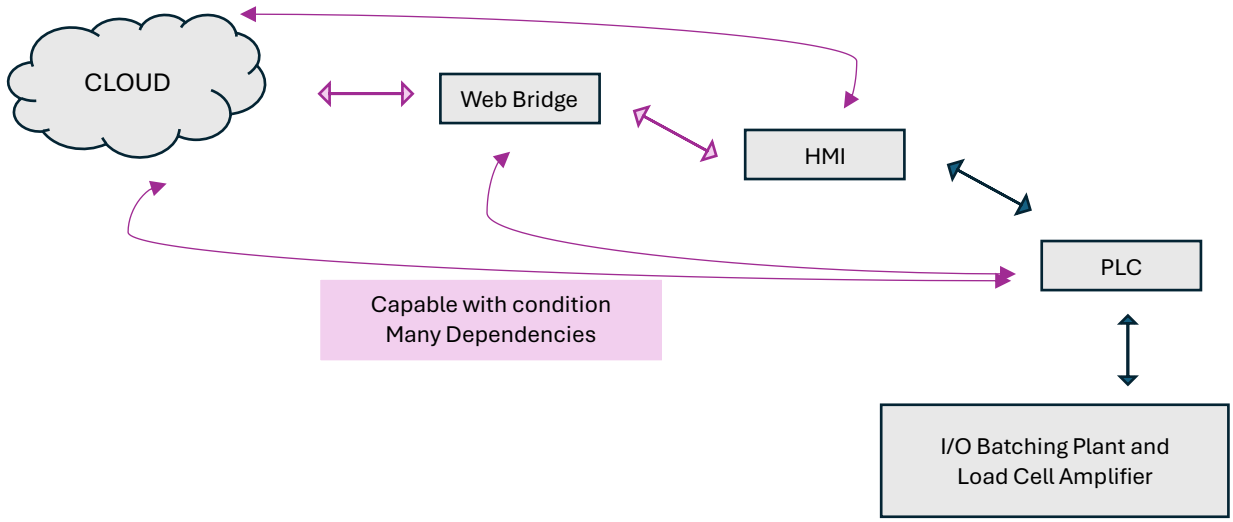
- Fast message response
- Custom low-level C/C++ driver handling
- No OPC server required
- High performance in constrained environments

## Author Contribution

This system and all components described in this document—including the architecture, PLC protocol implementation, runtime modules, backend services, data intelligence layer, and on-site commissioning—were fully designed and developed by the author.

Note :

***Comparison with existing batching plant Architecture**




## 🔍 Comparison with Legacy Batching Systems

| Feature | Legacy Systems | Orchestrix |
|---|---|---|
| OEE Support | ❌ | ✔ |
| ERP Integration | ❌ | ✔ |
| Reporting & Analytics | ❌ | ✔ |
| Real-Time Logs | ❌ | ✔ |
| Multi-Plant Control | ❌ | ✔ |
| PLC Brand Compatibility | Limited | Broad |

** Custom Module I/O

ARM Based, high speed and support multiple machine types.