

Commissioning and Documentation procedure Example: Automated Bottling Plant

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Project Overview

This project involves **commissioning an Automated Bottling Plant** for a beverage manufacturer. The plant includes **PLC-controlled filling, capping, and labelling machines integrated into a single production line**. The system is monitored and controlled via SCADA for real-time data visualization and remote control.

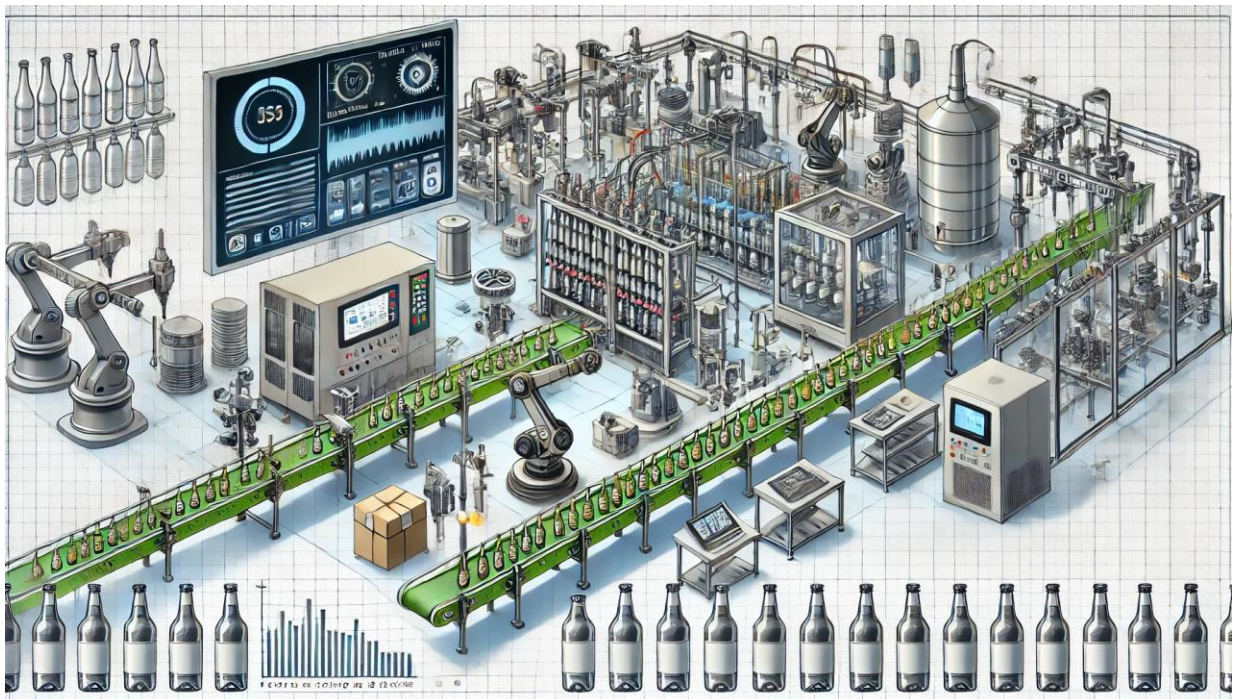


Figure 1. An illustration of an automated bottling plant

1. Pre-Commissioning Phase

1.1 Hardware Setup & Installation

- Install Siemens S7-1500 PLC as the main controller.
- Connect HMI Comfort Panel for operator interaction.
- Configure Profinet communication for distributed I/O devices.
- Install sensors:
 - Flow meters for liquid dispensing.
 - Proximity sensors for bottle detection.

- Load cells for weight verification.
- Barcode scanners for product tracking.
- Wire VFDs (Variable Frequency Drives) to control conveyor speeds.

1.2 Software Configuration

- TIA Portal setup:
 - Create PLC program with ladder logic and function blocks.
 - Implement interlocks to prevent machine damage.
 - Configure PID loops for precise liquid dispensing.
 - Set up fault handling and safety logic.
 - SCADA System (WinCC Professional)
 - Design dashboards for real-time monitoring.
 - Configure alarms for equipment failures.
 - Enable historical data logging for analysis.
 - Communication Setup
 - Establish OPC UA connection for cloud data transfer.
 - Implement Modbus TCP for third-party device integration.
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2. Commissioning Phase

2.1 System Testing

- Power-On Testing:
 - Verify correct voltage and wiring.
 - Check network connections (Profinet, OPC UA).
- I/O Testing:
 - Test sensors, actuators, and VFDs using TIA Portal's online mode.
 - Ensure accurate bottle detection and rejection mechanism.
- Functional Testing:
 - Run manual mode to test each machine separately.
 - Validate automatic operation with real bottles.
 - Monitor system responses to simulated faults.
- PID Tuning:

- Adjust flow control to maintain consistent fill levels.
 - Optimize VFD speeds for smooth production flow.
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3. Performance Validation

3.1 Production Run

- Conduct an initial test batch and record performance.
- Measure key KPIs:
 - Cycle time per bottle
 - Liquid fill accuracy
 - Downtime incidents
- Compare results with expected values and adjust as needed.

3.2 Safety & Compliance Checks

- Conduct emergency stop tests.
 - Ensure compliance with ISO 13849-1 (Safety of Machinery).
 - Validate food-grade sanitary requirements for beverage production.
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4. Final Documentation & Handover

4.1 Operator & Maintenance Training

- Train plant staff on PLC operation and troubleshooting.
- Provide manuals for:
 - HMI operation
 - SCADA data analysis
 - Preventive maintenance procedures

4.2 Project Documentation

- Final PLC Program & Code Documentation
 - I/O Mapping Sheet
 - Network Configuration & IP Address List
 - Alarm & Error Handling Guide
 - Maintenance & Spare Parts List
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5. Post-Commissioning Support

- Remote monitoring setup for performance tracking.
 - Scheduled follow-up visits to fine-tune operations.
 - Technical support for software updates and system modifications.
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Outcome:

The commissioning of the Automated Bottling Plant ensures seamless production, reducing errors, improving efficiency, and enabling predictive maintenance through SCADA and cloud connectivity.