Digital Twin Driven Intelligent System for Cost-Optimized Manufacturing

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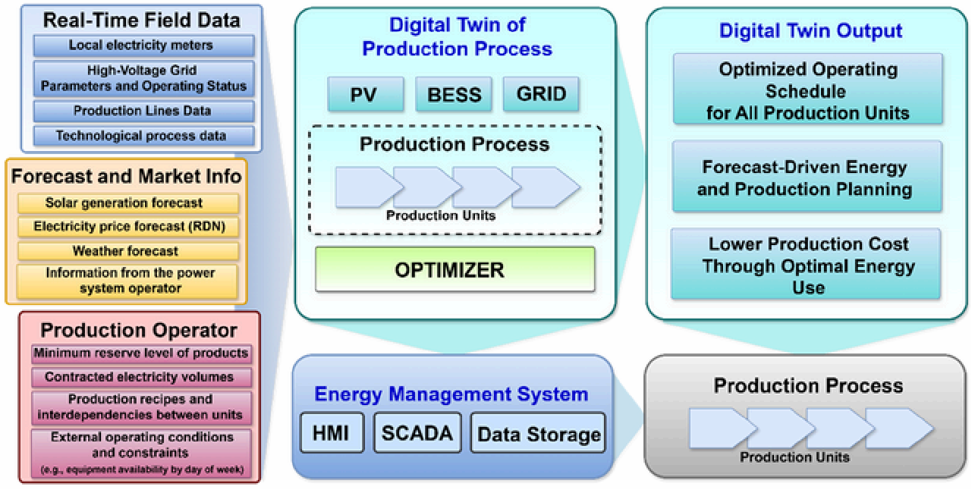
The system integrates solar generation and electricity price forecasts with a Digital Twin of the production process. By evaluating multiple production scenarios, it determines the optimal operating strategy for each production unit and defines the appropriate operating modes of the BESS. This provides a measurable reduction in grid electricity consumption and a significant decrease in overall production cost. The Intelligent System aligns with the development trends of Industry 4.0 and the emerging Industry 5.0 paradigm.

OPEX Reduction

- Significant reduction of electricity costs through optimization of production unit schedules during low-price periods (e.g., RDN, day-ahead).
- Minimization of energy purchased during high-tariff periods by forecasting and planning the start times of energy-intensive processes.
- Improved utilization of contracted electricity volumes and reduction of imbalance penalties.



Increased Utilization of On-Site Solar Generation

- Maximization of PV self-consumption enabled by integrating weather forecasts, solar generation forecasts, and technological constraints.
- Reduced grid electricity consumption and lower carbon footprint of production.
- A more predictable and stable energy consumption profile.

Improved Efficiency of the Technological Process

- Optimization of production unit operation considering recipes, inter-unit dependencies, minimum operating times, reserve constraints for finished products, and equipment availability schedules.
- Increased throughput without additional energy consumption through precise coordination of the production plan and energy profile.
- Automatic generation of an operational plan aligned with technological process models.

Enhanced Operational Transparency

- The Digital Twin forecasts production and warehouse operations and monitors the current state of the production complex.
- Accurate forecasts of load, energy cost, and equipment availability enable operators to make data-driven rather than assumption-based decisions.
- A “what-if” scenario analysis tool for evaluating the impact of various production and pricing scenarios.

Integration into Existing Industrial Infrastructure

- Integration with the existing SCADA system via OPC UA and Modbus TCP.
- Use of current data channels: local electricity meters, high-voltage grid connection, production lines, technological parameters, and power system operator data.
- Visualization and HMI remain within the plant’s SCADA – preserving existing workflows for operating personnel.

Interested? **Let’s discuss!**

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