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# SMART AUTOMATION FOR LEAN FOOD MANUFACTURING: REDUCING WASTE AND PROMOTING SUSTAINABILITY

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Lean manufacturing in Europe's food sector is evolving into Lean 4.0, where classical lean tools are reinforced by Industry 4.0 automation. This convergence supports the EU Green Deal and «Farm-to-Fork» Strategy, which demand low-emission, zero-waste food production (European Commission, 2023).

Lean principles – codified by Womack & Jones (2003) deliver far greater impact when paired with smart-factory technologies such as PLC networks, industrial IoT sensors and robotic process automation. A Thai noodle-plant study that embedded IoT data capture in a Lean-Kaizen programme achieved a 7.8 % rise in productivity, 12 % shorter cycle time and 9 % lower operating cost (Pitjarnit et al., 2024).

Across 156 European food manufacturers, firms that combine lean practices with Industry 4.0 enablers report 18 % better on-time delivery, 21 % fewer defects and 11 % lower specific energy use compared with conventional lean adopters (Psomas & Deliou, 2024). Reviews of “Food Processing 4.0” further show that AI-driven predictive maintenance typically cuts unplanned downtime by one-third while smart vision systems intercept defects in milliseconds, preventing full-batch re-work and resource loss (Hassoun et al., 2023).

By overlaying live dashboards of energy, water, material yields and defect rates onto value-stream maps, manufacturers can expose hidden wastes—waiting, re-processing, overproduction and excess utilities and intervene immediately. Integrating lean with advanced automation boosts productivity, safeguards quality and slashes resource intensity. In an era of strict climate targets and volatile input costs, the food sector cannot afford to underestimate or delay adoption of Lean 4.0; implementation has become essential for competitive, climate-responsible manufacturing in Europe.

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